WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Experimental Investigation of Polycarbonate Circular Slab

[1]A. Jerum Jestin M, [2]Edwin Fernando. P. A

[1]PG Scholar, Department of Civil Engineering, Akshaya College of Engineering and Technology. jerumjestin@gmail.com
[2]Assistant Professor, Department of Civil Engineering, Akshaya College of Engineering and Technology. edwinfernando@acetcbe.edu.in

ABSTRACT—

Earthquake is the most important factor in the design and construction of a structure as it produces collapse of a structure, loss of life, property. From every past earthquake it is clearly evident that they will bring greater damage to all structures andeven have an effect to collapse them. So it is very important to clearly understand the seismic behavior of the structure to have a effective design and construction. Even though the amount seismic load that can be designed accordingly to withstand the load which has the most probability of occurring in its life time. The main aim of this project is to use the polymer matrix composites in the earthquake prone zones to give stability to the structures. As an application if an element (slab) resist earthquake loads then these polymer matrix composites can be used as helipads in the regions.

Keywords: *Thermoplastics, Reinforcement Phase, Epoxy , Acrylic , Polyester , Twaron-Reinforcement, E-Glass , Carbon ,*

Introduction

Past three decades, The researches gave much attention to seismicity and the usage of composite materials as the replacement of constituent materials in concrete. Acomposite 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.Polymer matrix composites (PMCs) are comprised of a variety of short or continuous fibres bound together by an organic polymer matrix. Unlike a ceramic matrix composite (CMC), in which the reinforcement is used primarily to improve the fracture toughness, the reinforcement in a PMC provides high strength and stiffness. The PMC is designed so that the mechanical loads to which the structure is subjected in service are supported by the reinforcement. The function of the matrix is to bond the fibres together and to transfer loads between them. PMCs are often divided into two categories: reinforced plastics, and so-called advanced composite which have been in use for only about 15 years, primarily in the aerospace industry, consist of fibre and matrix combinations that yield superior strength and stiffness. They are relatively expensive and typically contain a large percentage of high-performance continuous fibres, such as high-stiffness glass (S- glass),graphite, aramid, or other organic fibres. Less than 2 percent of the material used in the reinforced plastics/PMCs industry goes into advanced composites for use in high-technology applications such as aircraft and aerospace.

Chemical Composition of Portland Cement

Chemical Ingredients	Content in Percentage
CaO (Lime)	60 - 67
SiO2 (Silica)	17 - 25
Al2O3 (Alumina) & CaSO4 (Calcium Sulphate)	3- 8
Fe2O3 (Iron Oxide)	0.5 - 6
MgO (Magnesia)	0.1 - 4
Alkalies	0.4 - 1.3
Sulphur	1 - 3

Figure.1 Twaron-Reinforcement Phase

Aramid fibers are a class of heat-resistant and strong synthetic fibers. They are used in aerospace and military applications, for ballistic-rated body armor fabric and ballistic composites, in bicycle tires, and as an asbestos substitute. The name is a portmanteau of "aromatic polyamide". They are fibers in which the chain molecules are highly oriented along the fiber axis, so the strength of the chemical bond can be exploited. In general the properties of aramid are good resistance to abrasion, good resistance to organic solvents, nonconductive, no melting point,degradation starts from 500 °C, low flammability, high Young's modulus, high tenacity, low creep.

Compressive Strength Of Cement

The compressive strength of hardened cement is the most important of all the properties. Therefore, the cement has to be tested for its strength at the laboratory before it is used in important works. Strength test are not made on neat cement paste because of difficulties of excessive shrinkage and Unlike a ceramic matrix composite (CMC), in which the reinforcement is used primarily to improve the fracture toughness, the reinforcement in a PMC provides high strength and stiffness. The PMC is designed so that the mechanical loads subsequent cracking of neat cement. Strength of cement is indirectly found on cement sand mortar in specific proportions.

555gms of standard sand, 185gms of cement are taken in a non-porous enameltray and mix them with a trowel for one minute, then add water of quantity p/4+3.0 percent of combined weight of cement and sand and mix the three ingredients thoroughly until the mixture is of uniform colour.The time of mixing should not be less than 3 minutes nor more than 4 minutes.After mixing, the mortar is filled into a cube mould of size 7.06cm.The mortar is compacted either by hand compaction in a standard specifiedmanner or on the vibrating equipment (12000 RPM) for 2 minutes.The compacted cube is kept in the mould at a temperature of $27^0C \pm 2^0C$ and at least90 percent relative humidity for 24 hours.After 24 hours the cubes are removed from the mould and immersed in cleanfresh water until taken out for testing.There cubes are tested for compressive strength at 3, 7, 28 days.

STANDARD CONSISTENCY TEST ON CEMENT

For finding out initial setting time, final setting time and strength, a parameter known as standard consistency has to be found. The standard consistency of a cement paste is defined as that consistency which will permit a Vicat plunger having 10 mm diameter and 50 mm length to penetrate to a depth of 30-35 mm from top of the mould. The apparatus is used to find out the percentage of water required to produce a cement paste of standard consistency. The standard consistency of cement The standard consistency of a cement paste is defined as that consistency which will permit a Vicat plunger having 10 mm diameter and 50 mm length to penetrate to a depth of 30-35 mm from top of the mould.

Type of cement	Days	Load KN	Compressive strength MPa
53 Grade OPC	3 Days	134.57	27
	7 Days	184.42	37
	28 Days	264.17	53

pH TEST OF WATER

In chemistry, pH is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are basic or alkaline. Pure water has a pH very close to 7.The pH scale is traceable to a set of standard solutions whose pH is established by international agreement. Primary pH standard values are determined using a concentration cell with transference, by measuring the potential difference between a hydrogen electrode and a standard electrode such as the silver chloride electrode. Measurement of pH for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators.pH measurements are important in medicine, biology, chemistry, agriculture, forestry, food science, environmental science, oceanography, civil engineering, chemical engineering, nutrition, water treatment & water purification, and many other applications.

A 0.1 pt. (50 mL), wide - mouth glass beaker with a watch glass for cover can be used. If lightweight material is to be tested, it may be necessary to increase beaker size up to a maximum of 0.5 pt.

(250 mL). Standard buffer solutions of known pH values - standards to be used are pH of 4.0, 7.0, and 10.0

SIEVE ANALYSIS

Sieve analysis is an operation of dividing a sample of aggregate into various fractions each consisting of particles of the same size.A convenient system of expressing the gradation of aggregates is one in which consecutive sieve openings are constantly doubled, such as 10mm, 20 mm, 40 mm, etc., and

such a system employs a logarithmic scale. Lines can be spaced at equal intervals to represent the successive sizes The aggregates used for making concrete are normally of the size 80 mm, 40 mm, 20 mm, 10 mm, 4.75 mm, 2.36 mm, 600 micron, 300 micron and 150 micron. Grading pattern of a sample of C.A. or F.A. is assessed by sieving a sample successively through the entire sieves mounted one over the other in order of size, with larger sieve on the top. The material retained on each sieve after shaking, represents the fraction of aggregate coarser than the sieve. Sieving can be done either manually or mechanically. If the sieving is done manually the sieve is shaken by giving moments

Figure 5.2 Sieve Analysis

SPECIFIC GRAVITY

Specific gravity is the ratio of weight of the sample in air for its taken volume dry conditions to the weight of an equal volume of distilled water specific gravity of aggregate is made use of in design calculations of concrete mixes with specific gravity of each constituent known, its weight can be converted into a solid volume and hence a theoretical yield of concrete per unit volume can be calculated. The specific gravities of fine, coarse aggregates and cement are given in table 5.5, 5.6, and 5.7.Specific gravity of aggregate is also required in calculating the compaction factor in connection with the workability measurements. Similarly the specific gravity of aggregate has to be considered when dealing with light weight and heavy weight concrete. Average specific gravity of rocks varies from 2.6 to 2.8.

W1	=	Empty wt. of Pycnometer
W2	=	Wt. of Pycnometer + FA
W3	=	Wt. of Pycnometer + FA + water
W4	=	Wt. of Pycnometer + water

IMPACT VALUE TEST ON COARSE AGGREGATE

With respect to concrete aggregates, toughness is usually considered as the resistance of the material to failure by impact. Several attempts are made to develop a method to test the impact value of aggregate. The values can be referred from IS 2386 (part IV). The impact values of coarse aggregates are given in the Table 5.9.

CRUSHING VALUE TEST ON COARE AGGREGATES

The principle mechanical properties required in stones are (i) satisfactory resistance to crushing under the roller during construction and (ii) adequate resistance to surface abrasion under traffic.Aggregates used in constructishould be strong enough to resist crushing under loads. If the aggregates are weak, stability of pavement structure is likely to be adversely affected. The strength coarse aggregate is assessed by aggregate crushing test. The aggregate crushing value provides a relative measure of resistance to

crushingunder gradually applied compressive load. To achieve a high quality of pavement aggregate possessing low aggregate crushing value should be preferred.

WATER ABSORPTION TEST

Some of the aggregates are porous and absorptive. Porosity and absorption of aggregate will affect the water/cement ratio and the workability of concrete. The porosity of aggregate will also affect the durability of concrete when the concrete is subjected to freezing and thawing and when the concrete is subjected to chemically aggressive liquids.

WATER ABSORPTION FOR COARSE AGGREGATECALCULATION

Weight of drysample W1 = 500gm Weight of immersed in water after 24hrs W2= 501gm

Water absorption in %= [(W2 - W1) / W1)] X 100

= [(500.5 – 500) / 500] X 10

= 0.5 %

MEASUREMENT OF WORKABILITY

The workability of a fresh concrete is a composite property which includes the diverse requirements of stability, mobility, placing ability and finishing ability. There are different methods for measuring the workability. Each of them measures only particular aspects of it and there is no unique test which measures workability of concrete in its totality. The test measures the relative effort required to change a mass of concrete from definite shape to another by means of vibration.

SLUMP CONE TEST

Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in the laboratory or at the site of work. It is not a suitable method for very wet or very dry concrete. It does not measure all factors contributing to workability, nor is it always representative of the placing ability of the concrete. However, it is used conveniently as a control test and gives an indication of the uniformity of concrete from batch to batch. The slump cone values for different types of mixes are given in the table 6.1 The apparatus for conducting the slump test essentially consists of a metallic mould in the form of a frustum of a cone having the internal dimensions as under.

The thickness of the metallic sheet for the mould should not be thinner than 1.6 mm.

COMPACTION FACTOR TEST

Compaction factor test is conducted to determine the degree of compaction. For the standard amount of work and thus offer a direct and reasonably reliable assessment of the workability of concrete. The test require measurement of the weight of the partially and fully compacted concrete and the ratio of partially compacted weight to the fully compacted weight, which is always less than one, is known as compacted factor. For a normal range of concrete the compaction factor lies between 0.8

- 0.92.The compaction factor values are given in the table 6.2

PROCEDURE

The sample of concrete is placed in the upper hopper up to the brim. The trap-door is opened so that the concrete falls into the lower hopper.Then the trap-door of the lower hopper is opened and the concrete is allowed to fall into the cylinder. In the case of a dry-mix, it is likely that the concrete may not fall on opening the trap-door. In such a case, aslight poking by a rod may be required to set the concrete in motion.

The outside of the cylinder is wiped clean. The concrete is filled up exactly up to the top level of the cylinder.It is weighed to the nearest 10 grams. This weight is known as weight of partially compacted concrete.The cylinder is emptied and then refilled with the concrete from the same sample in layers approximately 5cm deep.

The layers are heavily rammed or preferably vibrated so as to obtain full compaction.The top surface of the fully compacted concrete is then carefully struck off level with the top of the cylinder and weighed to the nearest 10 gm. This weight is known as ―weight of fully compacted concrete.

Testing ofhardened concrete plays an important role in controlling and confirming the quality of cement concrete works. Systematic testing of raw materials, fresh concrete and hardened concrete are inseparable part of any quality control program for concrete, which helps to achieve higher efficiency of the material used and greater assurance of the performance of the concrete with regard to both strength and durability. The test methods should be simple, direct and convenient to apply.One of the purposes of testing hardened concrete is to confirm that the concrete used at site has developed the required strength. As the hardening of the concrete takes time, one will not come to know, the actual strength of concrete for some time. This is an inherent disadvantage in conventional test.

COMPRESSION TEST ON CONCRETE

Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform, and partly because most of the desirablecharacteristic properties of concrete are qualitatively related to its compressive strength.The compression test is carried out on specimens cubical or cylindrical in shape.Sometimes, the compression strength of concrete is determined using parts of a beam tested in flexure. The end parts of beam are left intact after failure in flexure and, since the beam is usually of square cross section, this part of the beam could be used to find out the compressive strength.

In assembling the mould for use, the joints between the sections of the mould are thinly coated with mould oil and a similar coating of mould oil is applied between the contact surface of the bottom of the mould and the base plate in order to ensure that no water escapes during the filling.The interior surfaces of the assembled mould is also required to be thinly coated with mould oil to prevent adhesion of concrete.

A steel bar 16 mm in diameter, 0.6 m long and bullet pointed at the lower end serves as a tamping bar.

The test cube specimens are made as soon as practicable after mixing and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance.

The concrete is filled into the mould in layers approximately 5 cm deep.

The standard tamping bar is used for hand compaction and the strokes of the bar are distributed in a uniform manner over the cross- section of the mould. The number of strokes per layer required to produce the specified conditions vary according to the type of concrete. For cubical specimens, in no case should the concrete be subject to less than 35 strokes per layer for 15 cm or 25 strokes per layer for 10 cm cubes.

After the top layer has been compacted the surface of the concrete is brought to the finished level with the top of the mould, using a trowel. The top is covered with a glass or metal plate to prevent evaporation.

The test specimens are stored in place free from vibration, in moist air of at least 90% relative humidity and at a room temperature for 24 hours from the time of addition of water to the dry ingredients.

SPLIT TENSILE TEST ON CONCERTE

The tensile strength is one of the basic and important properties of the concrete.The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack.The cracking is a form of tension failure.

PROCEDURE

The specimens are stored in water at a temperature of 24 c to 30 c for 48 hours testing. They are tested immediately on removal from the water whilst they are still wet condition.

The dimension of each specimen is noted before testing.The bearing surface of the supporting and loading rollers is wiped clean and any loose sand or other materials are removed from the surface of the specimen where they are to made contact with the rollers.

The specimen is placed in the machine in such manner that the load is applied to the upper most surface as cast in the mould.

The axis of specimen is carefully aligned with the axis of the loading device.The load is applied without shock and increasing continuously at rate of the specimen.

The load is increased until the specimen fail and maximum load applied to the specimen during the test is recorded. The load is increased until the specimen fail and maximum load applied to the specimen during the test is recorded.

FLEXURAL STRENGTH OF CONCRETE

Concrete as we know is relatively strong in compression and weak in tension. In reinforced concrete members, little dependence is placed on the tensile strength of concrete since steel reinforcing bars are provided to resist all tensile forces. However, tensile stresses are likely to develop in concrete due to drying shrinkage, rusting of steel reinforcement, temperature gradients and many other reasons. Therefore, the knowledge of tensile strength of concrete is of importance.

A concrete road slab is called upon to resist tensile stresses from two principal sources- wheel loads and volume change in the concrete. Wheel loads may cause high tensile stresses due to bending, it there is an inadequate subgrade support its volume changes, resulting from changes in temperature and moisture, may produce tensile stresses, due to warping and due to the movement of the slab along the subgrade.

Direct measurement of tensile strength of concrete is difficult. Neither specimens testing apparatus have been designed which assure uniform distribution of the "pull" applied to the concrete. While a number ofinvestigationsinvolvingthedirect measurement of tensile strength have been made, beam tests are found to be dependable to measure flexural strength property of concrete.

Specimens 10 x 10 x 50 cm is used.

The mould is of metal, preferably steel or cast iron and the metal is of sufficient thickness to prevent spreading or warping.

The mould is constructed with the longer dimension horizontal and in such a manner as to facilitate the removal of the moulded specimens without damage.

The tamping bar is a steel bar weighing 2 kg, 40 cm long and should have a ramming face 25 mm square.

The mould is constructed with the longer dimension horizontal and in such a manner as to facilitate the removal of the moulded specimens without damage.

The tamping bar is a steel bar weighing 2 kg, 40 cm long and should have a ramming face 25 mm square. The bed of the testing machine is provided with two steel rollers, 38 mm in diameter, on which the specimen is to be supported, and these rollers should be so mounted that the distance from centre to centre is 60 mm for15 cm specimen or 40 cm for 10.0 cm specimens.

The bearing surfaces of the supporting and loading rollers are wiped clean, and any loose sand or other material removed from the surfaces of the specimen where they are to make contact with the rollers.

The specimens are stored in water at a temperature of 24 c to 30 c for 48 hours testing.

They are tested immediately on removal from the water whilst they are still wet condition.

The specimen is placed in the machine in such a manner that the load is applied to the uppermost surface as cast in the mould, along two lines spaced20.0 or13.3 cm apart. The axis of the specimen is carefully aligned with the axis of the loading device.

The load is applied without shock and increasing continuously at a rate such that the extreme fibre stress increases at approximately 0.7 kg/sq. cm/min that is, at a rate of loading of 400 kg/min for the 15.0 cm specimens and at a rate of 180 kg/min for the 10.0 cm specimens.

The load is increased until the specimen fails, and the maximum load applied to the specimen during the test is recorded.

The appearance of the fractured faces of concrete and any unusual features in the type of failure is noted.

RESULT AND DISCUSSION

CRUSHING VALUE TEST ON COARE AGGREGATES

Aggregate crushing value=27.27 %

CONCLUSION

As this project is selected for council of scientific and industrial research-Structural engineering research Centre (CSIR-SERC) Tharamani, Chennai. The following had to be done in CSIR- SERC Campus:

The raw materials that are to be used for the project have to be purchased.These raw materials are to be produced into a composite material using suitable production techniques.Composite material is to be tested in the structural laboratory.

Using the data collected the various tests(Mechanical properties) are to be done experimentally.Investigation on the impact and dynamic loads are to be done.Composite member is to be tested for impact and dynamic loads.

REFERENCE

[1] Shuai Jiang Qifeng Li Junwei Wang, Zhenglong He, Yuhua Zhao andMaoqingKang,(2016_Multiscale graphene oxide–carbon fiber reinforcements for advanced polyurethane composites' Composites Part A: Applied Science and Manufacturing,pp:1-9.

[2] M. Mohamed, S. Anandan, Z. Huo, V. Birman, J. Volz and K. Chandrashekhara,(2015) _Manufacturing and characterization of polyurethane based sandwich composite structures' Composite Structures 123,pp: 169–179.

[3] Rahul S. Sikarwar , R. Velmurugan and N.K. Gupta,(2014) _Influence of fiber orientation and thickness on the response of glass/epoxy composites subjected to impact loading' Composites: Part B 60, pp: 627–636.

[4] A.C. Manalo,(2013)' Behaviour of fibre composite sandwich structures under short and asymmetrical beam shear tests' Composite Structures 99,pp: 339–349.

[5] Chand S. Review carbon fibers for composites. J Mater Sci 2000;35(6)pp:1303–13.

[6] Wu G, Ma L, Liu L, Wang Y, Xie F, Zhong Z, et al. Interface enhancement of carbon fiber reinforced methylphenylsilicone resincomposite modified with silanized carbon nanotubes. Mater Des 2016;89:pp1343–49.

[7] Jiang S, Li Q, Zhao Y, Wang J, Kang M. Effect of surface silanization of carbon fiber on mechanical properties of carbon fiber reinforced polyurethane composites. Compos Sci Technol 2015;110pp:87–94.

[8] Abdullah SA, Iqbal A, Frormann L. Melt mixing of carbon fibers and carbon nanotubes incorporated polyurethanes. J Appl Polym Sci 2008;110(1)pp:196–202.

[9] Manalo AC, Aravinthan T, Karunasena W, Islam MM. Flexural behavior of structural fiber composite sandwich beams in flatwise and edgewise positions. Compos Struct 2010;92pp:984–95.

[10] Dai J, Hahn HT. Flexural behavior of sandwich beams fabricated by vacuumassisted resin transfer molding. Compos Struct 2003;61pp:247–53.

[11] Reisa EM, Rizkalla S. Material characteristics of 3-D FRP sandwich panels.Constr Build Mater 2008;22:pp1009–18.

[12] Aref AJ, Alampalli S. Vibration characteristics of a fiber–reinforced polymer bridge superstructure.Des Manuf Compos Struct 2001;52pp:467– 74

[13] He M, Hu W. A study on composite honeycomb sandwich panel structure. Mater Des 2008;29:709–13.

[14] Karlsson KF, Astrom BT. Manufacturing and applications of structural sandwich components. Compos A 1997;28:97–111.

[15] International Standard. Fibre-reinforced plastic composites – determination of flexural properties, ISO 14125; 1998.

[16] International Standard. Plastics – determination of tensile properties 1; 1995.– part 1: general principles,ISO 527-

[17] Fibre-reinforced plastic composites – determination of compressive properties in the in- plane direction, ISO 14126;99.

[18] P.C. Varghese, _Limit State Design of Reinforced concrete'.