INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

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SPECIAL ISSUE FOR
2nd NATIONAL CONFERENCE ON
"Recent Trends and Development in Civil Engineering"

PREPLACED AGGREGATE CONCRETE USING LIGHT WEIGHT AGGREGATE

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Accepted Date: 22/12/2018; Published Date: 01/02/2019

Abstract: Two stage (Preplaced aggregate) concrete is produced by placing coarse aggregate in a form and later injecting a cement-sand grout, to fill the voids between aggregate particles. For economical and technical reasons two-stage concrete is particularly used for construction and repair of mass structures, especially foundation, underwater construction and in all kind of construction with closely spaced reinforcement. In this study we are trying to replace cement and fine aggregate by optimum replacement by fly ash by conducting compression and flexural tests.

Keywords: Pre placed, Aggregate, Concrete, Lightweight, Aggregate

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Access Online On:

www.ijpret.com

How to Cite This Article:

Kartik Dhar, IJPRET, 2019; Volume 7 (6): 126-131

PAPER-QR CODE

INTRODUCTION

Preplaced aggregate concrete

Preplaced Aggregate Concrete (P.A.C.) is densely packed graded coarse aggregate later filled with cement grout. It is preferred in structures where conventional concreting is not possible, e.g. underwater dam repairs, narrow cracks, etc. Graded aggregate is packed after cleaning and screening thoroughly and then cement grout (made of sand, cement, pozzolana, plasticizer/super-plasticizer and air entraining agents) is used to fill the voids under pressure. Flowable grout is mixed and pumped through a cavity and an overflow vent is also provided to check whether all the voids have been filled or not. Preplaced aggregate concrete reduces shrinkage of concrete, leading to higher bond ability and a stronger repair of underwater dam cracks.

Lightweight Concrete

In this project, we use expanded polystyrene beads instead of aggregate in order to decrease weight of concrete. The Expanded Polystyrene is a stable, low density Foam, which consists of 98% of air and 2% of polystyrene material. It has closed structure and cannot absorb water. It has good impact resistance. Polystyrene is packaging material in medical industry. Polystyrene is non-biodegradable material, so it creates disposal problems. Utilizing crushed polystyrene in concrete is good waste disposal method. The polystyrene beads can be easily merged into mortar or concrete to produce lightweight concrete with a wide range of density. An application of polystyrene concrete includes walls, cladding panels, tilt up panels and composite flooring. Polystyrene concrete was used to produce load bearing concrete wall, also as the material of construction for floating marine structures.

LITERATURE REVIEW

1. Production of A Green Lightweight Aggregate Concrete by Incorporating High Volume Locally Available Waste Materials

Published Year: 2017
Author: Javad Nodeh Farahani , Payam Shafigh , Hilmi Bin Mahmud

Lightweight concrete offers numerous benefits compared to normal weight concrete such as reduction in dead load and construction costs. One of the most common methods of producing structural lightweight concrete is the use of lightweight aggregates. The application of waste substances as cement substitutes or aggregates in concrete can support a solution in order to decrease negative influences of the concrete industry. One of the agricultural solid wastes derived from the industry of palm oil is oil palm shell (OPS) which processes about 50% lower weight compared to normal weight aggregates. The paper reports an investigation on the oil palm shell as coarse aggregate as well as fly ash and rice husk as supplementary cementitious material to generate more environmentally friendly lightweight concrete. Based on the

research findings, the environmentally friendly structural lightweight aggregate concrete has the potential to be made through combining three kinds of waste substances: oil palm shell as coarse aggregate and blended RHA-FA as a substitution for cement (by mass) up to 70%. The act of replacing the cement by blended RHA-FA in OPS concrete leads to density reduction.

2. Performance of Lightweight Foamed Concrete with Waste Clay Brick as Coarse Aggregate
Published Year: 2013
Author: Norlia Mohamad Ibrahim, Sham Shinar Saleh Uddin, Roshazita Che Amat, Nur Liza Rahim and Tengku Nuraiti TengkuIzhar

Performances of lightweight foamed concretes that are made from partial substitution of waste clay brick as coarse aggregate has been investigated in this study. The research aims were to identify the properties and characteristic of lightweight foamed concrete using waste clay brick as alternative materials to reduce the depletion of normal coarse aggregate from granite. Four different percentages of concrete mixtures using new coarse aggregate have been prepared that consist of 25%, 50%, 75%, and 100% waste clay brick. Foamed were injected into concrete mixture to produce lightweight concrete with appropriate proportions. The samples have undergone several testing including compression test, water absorption test, workability test and density test. From the results obtained, lightweight concrete that were produced with 25% substitution of waste clay brick showed the highest compressive strength of 25 MPa with density of 1647 kg/m3.

3. Experimental Study on Lightweight Aggregate Concrete
Published Year: 2010
Author: P. Sundar Kumar, M.J .Ratna KanthBabu, K. Sundara Kumar and K. Satish Kumar

Lightweight concrete (LWC) has been successfully used since the ancient Roman times and it has gained its popularity due to its lower density and superior thermal insulation properties. Compared with normal weight concrete (NWC), LWC can significantly reduce the dead load of structural elements, which makes it especially attractive in multi-storey buildings. However, most studies on LWC concern “semi-lightweight “concretes, i.e. concrete made with lightweight coarse aggregate and natural sand to manufacture the “total lightweight” concrete, more environmental and economic benefits can be achieved if waste materials can be used to replace the fine lightweight aggregate. With increasing concern over the excessive exploitation of natural aggregates, synthetic lightweight aggregate produced from environmental waste is a viable new source of structural aggregate material. The uses of structural grade lightweight concrete reduced considerably the self-load of a structure and permit larger pre-cast units to be handled. The mechanical properties of a structural grade lightweight aggregate made with fly ash and clay will be presented. It is well know that in general fly ash (FA) and silica fume (SF) increases the compressive strength, splitting tensile strength and flexural strength of concrete. In our study it was found that 10% replacement of fly ash and S.F. will increase the compressive

strength, tensile and flexural strength. When FA & SF was increased to 20% the compressive strength, flexural splitting tensile will be decreased. However if the FA addition to the concrete is too high the pacts effect of FA weakens because of positive inference and the secondary hydration reaction is delayed. The SF used in our test has high specific surface, high amorphous siO2 and small particle size only with such chemical and physical characteristics.

4. Light Weight Concrete Using EPS Beads and Aluminium Powder
Published Year: 2015
Author: Abhijitsinh Parmar, Urvish Patel, Aditi Parmar, Chahil Joshi, Avadh Vaghasiya, Akshay Joshi

With construction of structures expanding over the seas and a newfound focus towards sustainability. This wonderful material known as Expanded Polystyrene Concrete is known for its low density and environment friendly properties apart from having various other advantages like better heat and sound insulation, ease of construction and affordability. The success of this concrete is evident from its increasing usage in green buildings and sea structures all over the world. The freedom to tinker with the properties of the concrete by altering the making process and components gives greater flexibility to creative minds while emphasizing the fundamentals of concrete design. Aluminium is a forming agent the reaction with water produces hydrogen gas which makes air pockets in concrete which result in to lowering of density and makes it porous.

5. Experimental Study on Light Weight Aggregate Concrete with Pumice Stone, Silica Fume and Fly Ash as a Partial Replacement of Coarse Aggregate.
Published Year: 2014
Author: Lakshmi Kumar Minapu, M K M V Ratnam, Dr. U Rangaraju

In Design of concrete structures, light weight concrete plays a prominent role in reducing the density and to increase the thermal insulation. These may relate of both structural integrity & serviceability. More environmental and economic benefits can be achieved if waste materials can be used to replace the fine light weight aggregate. The new sources of Structural aggregate which is produced from environmental waste is Natural aggregates, synthetic light weight aggregate The use of structural grade light weight concrete reduces the self-weight and helps to construct larger precast units. In this study, an attempt has been made to study the Mechanical Properties of a structural grade light weight concrete M30 using the light weight aggregate pumice stone as a partial replacement to coarse aggregate and mineral admixture materials like Fly Ash and Silica Fume. For this purpose along with a Control Mix, 12 sets were prepared to study the compressive strength, tensile strength and flexural strength. Each set comprises of 4 cubes, 2 cylinders and 2 prisms. Slump test were carried out for each mix in the fresh state. 28-days Compressive test, Tensile Strength and Flexural Strength tests were performed in the hardened state. The study is also extended for blending of concrete with

different types of mineral admixtures. The test results showed an overall strength & weight reduction in various trails. Therefore, the light weight concrete is no way inferior for construction purpose.

6. Light weight concrete using recycled expanded polystyrene beads
Published Year: 2018
Author: AnkurTayal, Gaurav Gupta, Praveen Choudhary, TarunTomar, Nikhil Kumar, Sneh Mittal

Demand of lightweight concrete is increasing in the construction industry for the non-structural members. In this paper, coarse aggregates of concrete are replaced by Expanded Polystyrene (EPS) beads to achieve lightweight concrete. The main objective of this experiment was to compare the properties, such as compressive strength and heat insulation, of EPS concrete to the standard concrete cube. The cubes consists of 5%, 10%, 15%, 20%, 25%, and 30% EPS (by vol. of course aggregate) for M25 mix design. The cubes were tested at 7d, 14d and 28d of curing. The results obtained were compared with standard concrete sample.

7. Performance of Light-Weight Concrete with Plastic Aggregate
Published Year: 2015
Author: Anju Ramesan, Shemy S. Babu, Aswathy Lal

This study is intended to explore the suitability of recycled plastics (high density polyethylene) as coarse aggregate in concrete by conducting various tests like workability by slump test, compressive strength of cube and cylinder, splitting tensile strength test of cylinder, flexural strength of R.C.C as well as P.CC. Beams to determine the properties and behaviour in concrete. Effect of replacement of coarse aggregate with various percentages (0% to 40%) of plastic aggregate on behaviour of concrete was experimentally investigated and the optimum replacement of coarse aggregate was found out. The results showed that the addition of plastic aggregate to the concrete mixture improved the properties of the resultant mix.

CONCLUSION

Nowadays with advancement of technology, light-weight concrete usage has being taken up place of aggregate concrete. The two-stage concrete will be particularly used for not only construction and repair of mass structures, but also used in especially foundation, underwater construction and in all kind of construction with closely spaced reinforcement so it will more strengthen the structures, also decrease the weight of structure. By using this two-stage concrete, expenditure will be reduced.

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