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A REVIEW PAPER ON USE OF MARBLE DUST AND FURNACE SLAG BY REPLACING SAND IN PAVEMENT QUALITY CONCERTE OF RIGID PAVEMENT

Mubasir Baseer Zargar[1], Dr.Rakesh Gupta[2]

[1]*M.Tech Scholar, Civil Engineering Deptt; SRMIET, Bhurewala, Ambala, Haryana, India*
[2]*Assistant Professor, Civil Engineering Deptt. SRMIET, Bhurewala, Ambala, Haryana, India*

Abstract-*The demand for usage of industrial by-products and wastes in road pavements is increasing and becoming more important. Government policies and public awareness is also contributing to the enhancement of both this demand and utilization. Various slags such as blast furnace and steel slag have been widely used in road pavements. Therefore, it could be possible to prevent the environmental pollution and to consume fewer natural resources as well through its utilization in increasing demand for road construction*

The present study aims at developing pavement quality concrete mixtures incorporating marble dust and furnace slag as a partial fine aggregate replacement material. In this study the use of marble dust and furnace slag by replacing sand in pavement quality concrete of rigid pavement s are reported and the effect on the slab thickness of PQC pavement for the achieved strength of the concrete mixtures incorporating marble dust and furnace slag has also been studied.

The study shows that the marble dust cab be effectively replace sand up to 15% and furnace slag can be used up to 20% as replacement of sand in PQC. The maximum flexural strength is achieved for the mix containing 10% marble dust and 10% furnace slag as partial replacements of sand. The flexural strength increase is significant for mixes containing marble dust and furnace slag, with a combination up to certain limits of 25 to 30% in development of pavement quality concrete.

Key Words: *pavement quality concrete (PQC) , Dry lean concrete (DLC), marble dust (MD), furnace slag, sand*

1. INTRODUCTION

Concrete is a material that is used everywhere, serving as the core material of modern structures and our many miles of roadways. Modern concrete is composed of an aggregate that is bonded with fluid cement. The aggregate is basically bits of rocks and gravel that serve to reinforce and strengthen the concrete. Aggregates are the most mined materials in the world. Most modern concrete uses Portland cement and water. The Portland cement usually comes from limestone, and is turned into a fine powder that is produced by heating it to high temperatures. It is also called hydraulic cement, which means it hardens by reacting with water.

Cement concrete pavements represent the group of rigid pavements. The load carrying capacity is mainly due to rigidity and high modulus of elasticity of the slab.

Introduction of Concrete Pavement

The first strip of concrete pavement was completed in 1893; concrete has been used extensively for paving highways and airports as well as business and residential streets. There are four types of concrete pavement:

Plain pavements with dowels that use dowels to provide load transfer and prevent faulting,

Plain pavements without dowels, in which aggregate interlock transfers loads across joints and prevents faulting, conventionally reinforced pavements that contain steel reinforcement and use dowels in contraction joints, and continuously reinforced pavements that have no contraction joints and are reinforced with continuous longitudinal steel.

There are three main components of road pavement:

- Foundation
- Base
- Surfacing

The foundation comprise of some grade soil (cut or fill), capping and sub base. The foundation is designed to provide a certain standard quality of support for the higher layers. The base is the main structural layer of the pavement. Meanwhile, an asphalt surfacing compromise of a surface course and a binder course. The function of the surfacing is to enable good ride quality to be combined with appropriate resistance to skidding and resistance to crack formation.

A concrete pavement, in general, consists of three layers, compromising of a sub-grade, base layer and the concrete slab. Generally bound base layers are used for concrete pavement construction. As per Indian

specification, some example of such base layers are Dry Lean concrete (DLC), Roller Compacted Concrete (RCC) (IRC:15-2002). The concrete slab is generally of M40 to M50 grade of concrete as per Indian specifications, and is called as paving quality concrete (PQC).There are two methods for paving with concrete—slip form and fixed form. In slipform paving, a machine rides on treads over the area to be paved—similar to a train moving on a set of tracks. Fresh concrete is deposited in front of the paving machine which then spreads, shapes, consolidates, screeds, and float finishes the concrete in one continuous operation. This operation requires close coordination between the concrete placement and the forward speed of the paver. Fixed-form paving, stationary metal forms are set and aligned on a solid foundation and staked rigidly. Final preparation and shaping of the subgrade or subbase is completed after the forms are set. Forms are cleaned and oiled first to ensure that they release from the concrete after the concrete hardens. Once concrete is deposited near its final position on the subgrade, spreading is completed by a mechanical spreader riding on top of the preset forms and the concrete. The spreading machine is followed by one or more machines that shape, consolidate, and float finish the concrete. After the concrete has reached a required strength, the forms are removed and curing of the edges begins immediately.

2. LITERATURE REVIEW

Wang et.al (1972) [1] studied the response of rigid pavements subjected to wheel loadings using linear finite element model. The slab was modeled with medium thick plate elements assuming Kirchhoff plate theory. The foundation was considered to be as an elastic half space. Slab stresses and deflections were computed using finite element model with both a continuous foundation and Winkler foundation, and were compared to stresses computed using Westergaard's equation

M. Soliman (2013) [2] till date everyone has been using marble as a decorative building material. This research paper gives us other aspects of marble and its waste dust like its severe effect on environment, health and other economical uses. In the above study it has been found that the waste marble dust can be replaced by sand resulting the improvement, workability & performance of concrete. This waste marble dust is produced during the process of cutting,

Mohammed Nadeem and Arun D. Pofale et al. (2012) [3] replaced Coarse and fine aggregate by using industrial slag of partial replacement of 0, 30, 50, 70 and 100%. They Prepared M20, M30, and M40 grades were considers for a W/C ratio of 0.55, 0.45 and 0.40. They study in all the parameters compressive strength, split tensile strength and flexural strength, also they observed workability properties of concrete. They observed as 100% replacement there is 2 to 7% increase in compressive strength while in split tensile strength and flexural strength they observed increment is range of 5 to 8%.

Hebhoub et al. (2011) [4] investigated the use of waste marble aggregates in concrete. Today we are faced with an important consumption and a growing need for aggregates because of the growth in industrial production, this situation has led to a fast decrease of available resources. On the other hand, a high volume of marble production has generated a considerable amount of waste materials; almost 70 % of this mineral gets wasted in the mining, processing and polishing stages which have a serious impact on the environment

Joseph O. Afolayan, Stephan A. Alabi et al. (2013) [5] they replaced coarse aggregates fully with cupola slag in all mix and partial replaced of cement by slag cement. 0%, 2%, 4%, 6%, 8%, and 10% replacement of cement was taken. They conclude that higher strength is obtained for 2% cement replacement, while using 100% cupola slag aggregate. They only measure compressive strength, no study on about split tensile, flexure, and durability test

R.Balaraman and S. Anne Ligoria et al. (2015) [6] they had partially replaced fine aggregate and coarse aggregate by Cupola Slag. They were taken 0, 5, 10, 15, 20, 25, 50,and 100 % replacement. They only measure Compressive strength and split tensile strength. Maximum Value of compressive strength is 31.555 N/mm2 for M20 grade when coarse aggregate is replaced by 5% of cupola slag

3. DESCRIPTION AND MATERIAL TESTING

Portland cement

It is the most common type of cement in general use around the world as a basic ingredient of concrete, mortar, and non-specialty grout. It was developed from other types of hydraulic lime in England in the mid-19th century, and usually originates from limestone. It is a fine powder, produced by heating limestone and clay minerals in a kiln to form clinker, grinding the clinker, and adding 2 to 3 percent of gypsum. Several types of Portland cement are available. The most common, called ordinary Portland cement (OPC), is grey in color, but white Portland cement is also available

Coarse aggregates

Those particles that are predominantly retained on the 4.75 mm (No. 4) sieve and will pass through 3-inch screen are called coarse aggregate. The coarser the

aggregate, the more economical the mix. Larger pieces offer less surface area of the particles than an equivalent volume of small pieces. Use of the largest permissible maximum size of coarse aggregate permits a reduction in cement and water requirements. Using aggregates larger than the maximum size of coarse aggregates permitted can result in interlock and form arches or obstructions within a concrete form. That allows the area below to become a void, or at best, to become filled with finer particles of sand and cement only and results in a weakened area

Fine Aggregate

Those particles passing the 9.5 mm (3/8 in.) sieve, almost entirely passing the 4.75 mm (No. 4) sieve, and predominantly retained on the 75 μm (No. 200) sieve are called fine aggregate. For increased workability and for economy as reflected by use of less cement, the fine aggregate should have a rounded shape. The purpose of the fine aggregate is to fill the voids in the coarse aggregate and to act as a workability agent.

Marble dust

Marble waste as a by-product is a very important material which requires adequate environmental disposal effort. In addition, recycling waste without proper management can result in environmental problems greater than the waste itself. Marble dust is a waste product formed during the production of marble. A large quantity of powder is generated during the cutting process. The result is that about 25% of the original marble mass is lost in the form of dust. Leaving these waste materials to the environment directly can cause environmental problems such as increases the soil alkalinity, affects the plants, affects the human body etc. Marble powder can be used as an admixture in concrete, so that strength of the concrete can be increased. It is a solid waste material generated from the marble processing and can be used either as a filler material in cement or fine aggregates while preparing concrete. The production of cheaper and more durable concrete using this waste can solve to some extent the ecological and environmental problems

Blast Furnace Slag

Blast furnace Slag is a non-metallic by product produced in the process of iron production by chemical reduction in a blast furnace. It consists primarily of calcium silicates, alumina silicates, and calcium-alumina-silicates.

4. SCOPES FOR FURTHER WORK

In the present study experimental program was devised to study the strength characteristics of mixes containing marble dust and furnace slag. The work can be extended to study the durability characteristics as well.

The performance of the pavement quality concrete slabs containing marble dust and furnace slag can be evaluated by constructing the trial stretches. The behavior of these PQC slabs can be analyzed under repetitive loading for the fatigue life consumed.

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