Analysis The Compression Strength of Paver Block by Replacement of Aggregate Using Waste Marble

AMOL B. SALUNKE[1], PROF. URMILA R. KAWADE[2]
[1] *Student M.E, Dept. of Civil Engineering, Dr. Vitthalrao Vikhe Patil College of Engineering, Ahmednagar*
[2] *Assistant Professor, Dept. of Civil Engineering, Dr. Vitthalrao Vikhe Patil College of Engineering, Ahmednagar*

Abstract*— With recent infrastructural development in urban India, trend of using paved surface around the building or on road sides is increasing. Traditional Concrete paving bocks are the most suitable, economical and locally available material for such paving surface. They are widely used on footpaths, garden pathways, courtyard paving, bust stand sheds, parking areas and in industry for working area. At the same time, amount of construction waste generated is also increasing with increased infrastructural development. Marble stone industry waste is one of the construction wastes which is left unused by industries or only used for filling low lying areas etc. In this study attempt has been made to use marble stone industry waste as replacement for course aggregate used for manufacturing of traditional concrete paving blocks. Varying percentage of marble stone waste aggregates is considered and paving blocks are tested for water absorption, compressive strength and splitting tensile strength. The results shown that maximum 70 % of replacement of traditional aggregate with marble stone waste aggregate is possible for optimum results. In this paper material used for the study, methodology adopted, results of various tests and summery results are given. Using waste material is reducing the cost of manufacturing and also solving the problem of disposal of construction waste and thus helping in protecting environment.

Indexed Terms*— Paver Block, Marble Stone, Concrete, Aggregates.

I. INTRODUCTION

Transport or transportation is the movement of humans, animals and goods from one location to another. Modes of transport include air, land (rail and road), water, cable, pipeline and space. The field can be divided into infrastructure, vehicles and operations. Transport is important because it enables trade between people, which is essential for the development of civilizations. Transport infrastructure consists of the fixed installations, including roads, railways, airways, waterways, canals and pipelines and terminals such as airports, railway stations, bus stations, warehouses, trucking terminals, refuelling depots (including fuelling docks and fuel stations) and seaports. Terminals may be used both for interchange of passengers and cargo and for maintenance. Vehicles travelling on these networks may include automobiles, bicycles, buses, trains, trucks, people, helicopters, watercraft, spacecraft and aircraft. Transport plays an important part in economic growth and globalization, but most types cause air pollution and use large amounts of land. While it is heavily subsidized by governments, good planning of transport is essential to make traffic flow and restrain urban sprawl. During the study we are going to discuss a possible way for constructing the pavement blocks by using wastes. The experiment will be conducted with the proper utilization of the solid waste in construction of paver blocks without affecting the various mechanical properties such as compressive strength, flexure strength and split tensile strength. The waste which we are going to select is the waste generated by marble stone quarrying or at the time of its dressing. This waste marble product will be used for replacing the coarse aggregates by some defined percentage and tested. After testing we will be concluding our results and explaining their behaviour.

1.1 Paver Block

Paver block or Paving block is one of the most popular flexible surface treatment options for exterior pavement applications. These blocks are aesthetically pleasing, comfortable to walk on, extremely durable, and easy to maintain

Fig 1 Paver Block

Concrete blocks are mass manufactured to standard sizes. Hence, they can be easily interchanged. A typical concrete block has two surfaces - one is smooth, and the other is a rough surface. The concrete paving blocks are most suitable for heavy-duty applications, able to support substantial loads and resist shearing and braking forces.

1.2 Advantages of Paver Blocks

- Paver blocks do not need special maintenance as compared to concrete or asphalt surfaces. A simple water washing can help keep the blocks clean and bright.
- Paver blocks are very durable, and if they are adequately interlocked, they can easily last for about 20 years. Paver blocks can withstand hefty vehicular load as well.
- Paver blocks are available in different shapes and colors, making it very versatile. These blocks can be used at residential as well as commercial premises.
- Paver blocks are slip-resistant and skid resistant.
- Paver blocks can be used in any weather conditions.
- These paver blocks are very easy to install and do not need any special equipment for its installation.
- The most important advantage of paver blocks is that they can be easily replaced. If one of the blocks gets damaged, it can be easily removed and replaced with another one.

1.3 Waste Marble

Marble waste is produced from marble industries as a result of production. More production equals more waste, more waste creates environmental contamination. A high volume of marble production has generated a considerable amount of waste materials; almost 70% of the minerals gets wasted in the mining, processing and polishing stages which have a serious impact on the environment. Also, a large amount of marble is accumulating in the environment due to demolition of old structures having marble. This causes environmental pollution. An economically viable solution to this problem should include utilization of these waste materials for new products especially in construction applications which in turn minimizes the heavy burden on the nation's landfills, saves natural resources, energy and reduces environmental pollution.

Fig 2 Waste Marble Chip

II. METHODOLOGY

The properties of concrete are largely determined by the properties of the elements. Cement acts as a binding agent, building a strong bond between the particles. The properties of cement, the fine and durable material used in concrete are primarily responsible for its strength. As a result, experimental methods for studying the properties of objects are presented in this section.

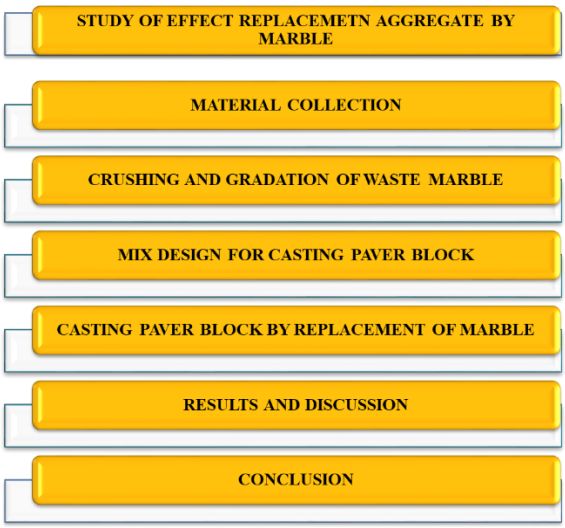


Fig 3 Flow of work

2.1 Casting of Specimens

After proper mixing of the concrete the specimen will be casted in two shape i.e. cubes and cylinder. 60 mm thick Milano/Cosmic Shape Pavers. Below table shows the details of the specimen to be casted.

Table 1 Details of Specimen

Grade of concrete	Cement (kg/m^3)	Fine aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	Marble (kg/m^3)	Water (Lt)
0%	158	749	1202	0	87
5%	158	749	1142	60	87
10%	158	749	1082	120	87
15%	158	749	1022	180	87
20%	158	749	962	240	87

Table 2 Details of specimens

Test	Specimen	All testing ages
Compressive strength	60 mm thick Milano/Cosmic Shape Pavers	7, 14 and 28 days
Water absorption	60 mm thick Milano/Cosmic Shape Pavers	28 days

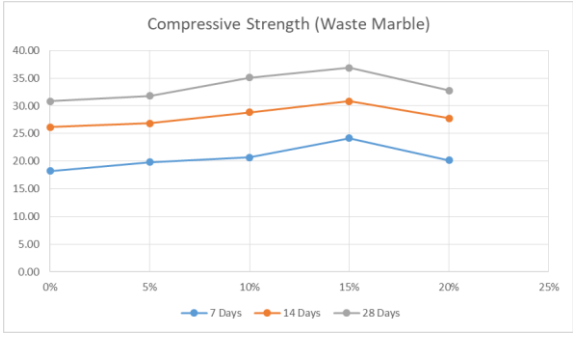
Fig. 4.3 casting of samples

III. EXPERIMENTAL INVESTIGATION

3.1 Summary of Compressive Strength (Waste Marble)

Table 3 Summary of Compressive Strength (Waste Marble)

Compressive Strength (Waste Marble)			
Percentage	7 Days	14 Days	28 Days
0%	18.20	26.13	30.806
5%	19.83	26.81	31.783
10%	20.67	28.82	35.075
15%	24.17	30.84	36.887
20%	20.16	27.72	32.762



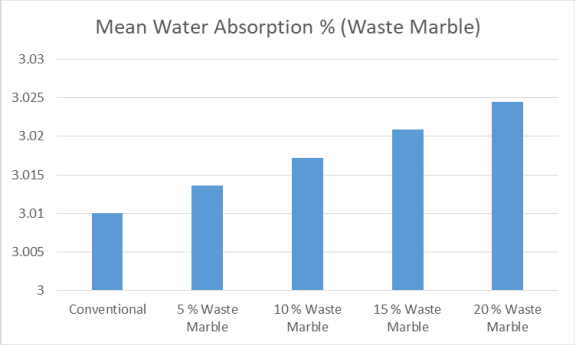
Graph 1 Summary of Compressive Strength (Waste Marble)

Above Results show that there is a increase in Compressive strength in replacement of waste Marble up to 15% at the age of 7, 14, 28 days and gets slightly decreased at the 20%.

3.2 Mean Water Absorption %

Table 4 Mean Water Absorption %

Sr. No.	ercentage replacement of Coarse Aggregate by Waste Marble	Mean Water Absorption %
1.	onventional	3.01
2.	% Waste Marble	3.014
3.	) % Waste Marble	3.017
4.	5 % Waste Marble	3.021
5.	) % Waste Marble	3.024



Graph 2 Mean Water Absorption %

Above graph shows the result for Water Absorption for 28 days of block with waste marble and it conclude that adding waste marble affects slightly on paver block for water Absorption.

CONCLUSION

- For the time being, experimental research has concentrated on M-20-grade concrete pavers with Waste Marble utilised as replacements for aggregates in varying percentages. 162 concrete paver blocks were tested with replacements of 5%, 10%, 15%, and 20% of Waste Marble.
- Inclusion of Waste Marble for aggregate reduces the slump values. This is due to the resistance for the free flow of concrete.
- From the test results obtained during the experiment work it is clear that the strength of Waste Marble concrete significantly higher than the normal concrete. The crack formation is also very small in mix specimen compared to normal specimen
- There is an increase in Compressive strength in replacement of waste Marble up to 15% at the age of 7, 14, 28 days and gets slightly decreased at the 20%.
- The result for Water Absorption for 28 days of block with waste marble and it conclude that adding waste marble affects slightly on paver block for water Absorption.
- Thus, we can conclude that using industrial waste like waste marble as a replacement for aggregate is a good option as strength is not compromised much and durability is also sufficient up to the 15% of replacement.

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