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Effect of Partial Replacement of Fine Aggregate by Alternative Materials in Paver Block

Walmik N. Bhalsing[1]. DR.U.R Kawade[2]
[1]*Student, Dr. Vithalrao Vikhe Patil College of Engineering, Ahmednager, Maharashtra*
[2]*Professor, Dr. Vithalrao Vikhe Patil College of Engineering, Ahmednager, Maharashtra*

Abstract
The need of concrete is increasing every year as the population of humans are increasing as per their demands i.e. infrastructure developments and shifting composition etc. Due to rising demands and fight to produce good quality of concrete, construction industries have overused the natural materials used in concrete, leads us to extinction in natural materials and results in rising prices of materials. Thus, the environmental problems related with excessive extraction and mining from natural sources have been reported in many countries. Due to finite availability of natural materials, and involvement of economy, it has now become very important to look as for the alternative source for natural materials used in concrete i.e. gravels and crushed sand. Metal swarf and ceramic tile waste is a propitious material that can be used as an alternative for the crushed sand i.e. (fine aggregates) in concrete. The paper demonstrates the potential of re-use for metal swarf and ceramic tile waste i.e. industrial by-product as a substitute of a fine aggregate in concrete. The fine aggregates i.e. (crushed sand) are replaced with fine metal swarf and ceramic tile waste in four different substitution rates i.e. (5%, 10%, 15%, and 20%). Tests were performed to examine the mechanical properties i.e. (compressive strength) as well as the durability of concrete i.e. (water absorption). The results indicate that the compressive strength after 28 days of concrete paver blocks was increased a little by replacing metal swarf by 5% weight of fine sand, compressive strength after 28 days of concrete paver blocks decreases by 7-8% for 10%, 15% and 20% replacement with metal swarf. Compressive strength after 28 days was decreased by replacing ceramic tile waste by 7-15% for 5%, 10%, 15% and 20% replacement. Water absorption increases by approximately 10% for each 5% replacement of metal swarf and water absorption increases drastically while replacing ceramic tile waste i.e. around 100% for 20% fine aggregate replacement with ceramic tile waste.
Keywords: *Fine metal swarf, ceramic tile waste, concrete, crushed sand, compressive strength, water absorption.*

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I. INTRODUCTION

Transport or transportation is the movement of humans, creatures and goods from one position to another. Modes of transport include air, land(rail and road), water, string, channel and space. The field can be divided into structure, vehicles and operations. Transport is important because it enables trade between people, which is essential for the development of societies. Transport structure consists of the fixed installations, including roads, railroads, airways, aqueducts, conduits and channels and outstations similar as airfields, road stations, machine stations, storages, trucking outstations, refueling depots(including fuelling jetties and energy stations) and seaports. Outstations may be used both for cloverleaf of passengers and weight and for conservation. Vehicles travelling on these networks may include motorcars, bikes, motorcars, trains, exchanges, people, copters, boat, spacecraft and aircraft. Transport plays an important part in profitable growth and globalization, but utmost types beget air pollution and use large quantities of land. While it's heavily subsidized by governments, good planning of transport is essential to make business inflow and restrain civic sprawl. During the study we're going to bandy a possible way for constructing the pavement blocks by using wastes. The trial will be conducted with the proper application of the solid waste in construction of paver blocks without affecting the colorful mechanical parcels similar as compressive strength, flexure strength and split tensile strength. The waste which we're going to elect is the waste generated by marble gravestone quarrying or at the time of its dressing. This waste marble product will be used for replacing the coarse summations by some defined chance and tested. After testing we will be concluding our results and explaining their geste .

Cement concrete paving blocks are precast solid products made out of cement concrete. The product is made in colorful sizes and shapesviz. blockish, square, and round blocks of different confines with designs for interlocking of conterminous paving blocks. The raw accoutrements bear for manufactures of the product are cement, beach and summations which are available locally in every part of the country. Potentially cement concrete paving blocks find operations in pavement, paths in auditoriums , passengers staying shanties, machine stops, assiduity and other public places. With infrastructural development in India, demand of paving blocks is adding day by day. At the same time quantum of different types of waste generated is also adding . thus control of waste disposal shall be given top precedence, while, on the other hand, recycling of waste effectively as raw material has come more important. Products which use recycled accoutrements could contribute significantly to conservation of the terrain in terms of both reducing waste and protection of nature. Some waste product can be used in construction sector. We tried for using waste product as the pavement block material. operation of waste accoutrements in concrete presents several advantages conserving mineral resource of a country similar as total and beach deduced from nature, precluding environmental pollution, also a positive on a country's frugality because of the high cost of waste storehouse.

1.1 Alternative for Crushed sand (Fine Aggregates)

The cost of crushed sand ultimately rises as a result of the crushed sand supply from natural sources approaching its limit. An alternate source that should be widely accessible and meet all necessary technical standards for fine aggregate is needed to meet the demand for sand in the modern building industry. Over the past few decades, extensive study has been done to identify a different source for a fine aggregate (crushed sand). As a result of constant research and development in the building industry, scientists have discovered that a number of waste materials have qualities that are nearly identical to those of fine aggregates.

Fine Metal Swarf: The cost of crushed sand ultimately rises as a result of the crushed sand supply from natural sources approaching its limit. The demand for sand as an alternative source that should be widely accessible and meet the necessary technical criteria for fine aggregate in modern times requires sustainable expansion in the construction industry. Over the past few decades, extensive study has been done to identify a different supply of fine aggregate (crushed sand). As a result of constant research and development in the building industry, scientists have discovered that a number of waste materials have qualities that are nearly identical to those of fine aggregates.

Ceramic Tile Waste: Almost all buildings employ ceramic tiles as major construction materials. These tiles are typically made starting with the raw materials, which are then ground and mixed, granulated by spray drying, pressed, fired and/or polished, and then glazed. About 2 wt% of the finished products are waste mud, which is the silt of washed-down particles from various production operations. This mud is far too impure to be reused in the creation of tiles; instead, it is typically disposed of as garbage in landfills. It contains both coarse particles (feldspar, quartz, and ground-fired tiles) and fine particles (clay minerals like kaolinite and mica). Due to the enormous volume of garbage produced annually and the rising expense of disposal, removal of this waste mud has grown increasingly difficult. Utilizing this trash for other purposes is one option to find a solution to this issue. The processing of ceramics results in the production of ceramic waste. These wastes pollute the groundwater, the air, and the soil. Mud and tile, which are the pollutants of the ceramics industry, are produced by the refinery systems of the ceramic factory and are kept there as waste. There is sufficient tile waste on the planet to be used as fine aggregate in concrete. Natural materials sintered at high temperatures are used to make tile.

II. EARLIER RESEARCH

Shani Singh et.al.(2021) The marble and determinedness diligence have grown extensively in recent decades. The determinedness assiduity in India produces over 3500 boxy measures of determinedness greasepaint sediment all day as waste material. determinedness penstocks directors frequently produce determinedness particulate matter tones although during the product process. The rejection of determinedness forfeitures from the polishing assiduity is a major concern. The polished determinedness greasepaint is reactive, but not disposable on the bottom. Stone waste is generally a heavily contaminating waste due to its high alkaline origin, which poses a health hazard to the terrain. Downstream waste affects soil quality due to reduced porosity, water retention, water percolation etc. As it's ditched on land. They beget severe waste and pollution of the atmosphere and need large areas of land for disposal. The polishing process attained the determinedness greasepaint and is held at 12 and 88 independently, by 150 microns. Due to its fineness and size, the determinedness greasepaint can be used effectively. This study describes the viability of partial cement relief with determinedness greasepaint in paver block construction. likewise, this study urges masterminds, contractors, and the government to consider substitute accoutrements for a better future.

Osman Gencel et.al.(2012) USA, Belgium, France, Spain, Sweden, Italy, Egypt, Portugal, Brazil and Greece are among the countries with considerable marble reserves. Turkey has indeed more, 40 of total marble reserves in the world. Seven million tons of marble are produced in Turkey annually. In processing marble similar as cutting to size and polishingetc. for ornamental purposes, marble dust and total are created as by-products. More specifically, during the slice process 20e30 of the marble block turns into dust. therefore, waste accoutrements from marble processing shops represent millions of tons. Marble assiduity produces large quantities of waste marble e what causes environmental problems. In paving blocks grounded on two cement types we've incompletely replaced total with waste marble. Physical and mechanical tests were performed on blocks so produced. The cement type turns out to be an important factor. Mechanical strength decreases with adding marble content while snap- thaw continuity and abrasive wear and tear resistance increase. Waste marble is well usable rather of the usual total in the concrete paving block product.

KhandveP.V. et.al.(2015) Cement concrete paving blocks are precast solid products made out of cement concrete. The product is made in colorful sizes and shapesviz. blockish, square, and round blocks of different confines with designs for interlocking of conterminous paving blocks. The raw accoutrements bear for manufactures of the product are cement, beach and summations which are available locally in every part of the country. Potentially cement concrete paving blocks find operations in pavement, paths in auditoriums , passengers staying shanties, machine stops, assiduity and other public places. In this study attempt has been made to use marble gravestone assiduity waste as relief for course total used for manufacturing of traditional concrete paving blocks. Varying chance of marble gravestone waste summations is considered and paving blocks are tested for water immersion, compressive strength and splitting tensile strength. The results shown that maximum 70 of relief of traditional aggregate with marble gravestone waste total is possible for optimum results. In this paper material used for the study, methodology espoused, results of colorful tests and summery results are given. Using waste material is reducing the cost of manufacturing and also working the problem of disposal of construction waste and therefore helping in guarding terrain.

Khushboo Tiwari et.al.(2019) The first forms of road transport involved creatures, similar as nags(domesticated in the 4th or the 3rd renaissance BCE), oxen(from about 8000 BCE) or humans carrying goods over dirt tracks that frequently followed game trails. numerous early societies, including Mesopotamia and the Indus Valley Civilization, constructed paved roads. In classical age, the Persian and Roman conglomerates erected gravestone- paved roads to allow armies to travel snappily. Deep roadbeds of crushed gravestone underneath kept similar roads dry. The medieval Caliphate latterly erected navigator- paved roads. A paver is a paving gravestone, pipe, slipup or slipup- suchlike piece of concrete generally used as surface flooring. They're applied by pouring a standard concrete foundation, spreading beach on top, and also laying the pavers in the asked pattern. No factual glue or retaining system is used other than the weight of the paver itself except edging. Pavers can be used to make roads, driveways, quadrangles, walkways and other out-of-door platforms. This study investigates the possible way for constructing the pavement blocks by using wastes. The trial were conducted with the of proper application of the solid waste in construction of paver blocks without affecting the colorful mechanical parcels similar as compressive strength, flexure strength and split tensile strength. The waste which we're going to elect is the waste generated by marble gravestone quarrying or at the time of its dressing. The paver blocks were constructed by using the waste marble products after replacing the coarse total by some defined chance. These blocks were tested by different tests like compressive strength test, flexural strength test, and resolve tensile strength test. The compressive strength set up to be in between47.35 N/ mm2 to44.98 N/ mm2. But we observed that up to 40 relief of coarse total with marble gravestone generally doesn't show any major difference. The relief of coarse total with the marble gravestone generally doesn't affect the flexural strength of the paver blocks. In the same manner the split tensile strength of the paver blocks doesn't shows any effect by the relief of coarse total with marble monuments. The approximate value is set up to be46.5 N/ mm2.

Mrunali Indurkar et al. (2022) employed lathe metal debris as a fibre and added up to 30% by weight at a gap of 10% (i.e., 0%, 10%, 20%, and 30%) in M20 and M30 concrete grades. They compared fiber-reinforced concrete with lathe metal scrap (metal steel scrap) added in varying weight amounts to plain cement concrete. The compressive strengths of normal cement concrete and lathe metal scrap reinforced concrete (LMSRC) M20 and M30 are being compared analytically. Comparing LMSRC's 28-day compressive strength to normal cement concrete's 28-day compressive strength, it was discovered that LMSRC's strength was higher.

Lailesh Late et al. (2021) presented an experimental investigation employing fine and coarse waste glass to produce paver blocks. Some of the mechanical and physical characteristics of paving blocks with varying amounts of fine and coarse aggregate substitution in place of fine glass (FG) and coarse glass (CG). The test results revealed that because FG is pozolanic, replacing it with FA at a level of 20% by weight has a significant impact on the paving blocks' compressive strength, flexural strength, splitting tensile strength, and abrasion resistance when compared to the control sample. At a FG replacement level of 20%, the paving block samples exhibit compressive strength, flexural strength, splitting tensile strength, and abrasion resistance that are, respectively, 69%, 90%, 47%, and 15% higher than the control sample. According to their test results, FG at a concentration of 20% has the potential to be used in the manufacture of paving blocks. The beneficial effect on these properties of CG replacement with FA is small as compared with FG.

Shubhangi Kadam et al. (2021) dealt with the partial replacement of cement by waste plastic and sand by using ceramic waste. The samples of pavers were cast using plastic waste to replace 5%, 10%, 15%, and 20% of the cement, and ceramic waste to replace 10% of the sand, and they were examined after curing for 7, 14, and 28 days to examine changes in characteristics. They came to the conclusion that paver blocks made of plastic and ceramic quickly attained a very high compressive strength of 60.60 MPa. It was discovered that the compressive strength of plastic and ceramic paver blocks increased with replacement up to 15%; 10% replacement of plastic and ceramic results in slightly higher compressive strengths. The compressive strength is reduced somewhat by complete replacement with 20% plastic and 10% ceramic, resulting in 43.635 MPa. The strongest paver block was determined to have a maximum strength of 60.60 MPa at 15% plastic and 10% ceramic replacement, which is extremely high and suitable for light-weight traffic. [9]

J. Venkateswara Rao et al. (2020) compared the results of an experimental investigation on the compressive and flexural strength of traditional M-40 uni-paver concrete blocks with paver blocks made by combining partial replacements of the cement and fine aggregate with fly ash and pond ash, respectively. While maintaining the performance of the paver block in terms of its strength aspect, the incorporation of these industrial items led to the saving of cement and, as a consequence, an overall saving of roughly 10% in the economy per paver block manufacturing. The paver block used in this experimental study was a specimen with a zigzag shape and dimensions of 201 mm, 100 mm, and 80 mm. Initially, pond ash and fly ash were substituted for fine aggregate and cement, respectively, in percentages of 5, 10, 15, and 20. Following the replacement of the fine aggregate and cement, the mechanical properties of the paver blocks were used to assess how well they performed. They came to the conclusion that by substituting pond ash for 10% of the aggregate fines in conventional paver blocks, the compressive strength could be increased by 11%. The experimental study on the efficient use of industrial wastes, such as fly ash and pond ash, as an alternative source material for fine aggregate and cement. The amount of aggregate fines that pond ash could replace, up to 5%, yielded the greatest increase in flexural strength. Additionally, the efficient utilization of industrial wastes, including pond ash and fly ash, can reduce costs while simultaneously increasing the mechanical qualities of concrete paver blocks. [10]

III. OBESERVATIONS AND TEST RESULTS

We have used Paver Blocks by 5% replacement of fine aggregate by metal swarf = 15+3 = 18 pavers (15 pavers for compression tests after 7, 14, and 28 days, 3 pavers for water absorption). The same type of pavers are used for 10%, 15%, and 20% replacement.

Therefore, the total number of metal swarf-based paver blocks is 18+18+18+18 = 72 paver blocks.
The same number of pavers are used for ceramic tile waste-based concrete paver blocks. So the total tested paver blocks are 160 including conventional paver blocks. The compressive strength of paver blocks is estimated at 7, 14, and 28 days, and comparisons have been shown. Variation in water absorption due to replacement of fine sand with metal swarf has been shown.

PARTIAL REPLACEMENT OF FINE AGGREGATE BY FINE METAL SWARF

Mean Compressive Strength after 7 Days of metal swarf based concrete paver blocks

S.No.	Percentage replacement of Fine Aggregate by Fine Metal Swarf	Mean Compressive StrengthAfter 7 Days (N/mm^2)
1.	Conventional	22.93
2.	5 % Fine Metal swarf	23.37
3.	10 % Fine Metal swarf	22.1
4.	15 % Fine Metal swarf	20.92
5.	20 % Fine Metal swarf	19.25

Mean Compressive Strength after 14 Days of metal swarf based concrete paver blocks

S.No.	Percentage replacement ofFine Aggregate by Fine Metal Swarf	Mean Compressive StrengthAfter 14 Days (N/mm^2)
1.	Conventional	31.12
2.	5 % Fine Metal swarf	31.89
3.	10 % Fine Metal swarf	29.9
4.	15 % Fine Metal swarf	29.5
5.	20 % Fine Metal swarf	27.79

Mean Compressive Strength after 28 Days of metal swarf based concrete paver blocks

S.No.	Percentage replacement ofFine Aggregate by Fine Metal Swarf	Mean Compressive StrengthAfter 28 Days (N/mm^2)
1.	Conventional	34.202
2.	5 % Fine Metal swarf	34.88
3.	10 % Fine Metal swarf	33.17
4.	15 % Fine Metal swarf	32.84
5.	20 % Fine Metal swarf	30.13

Mean Water Absorption % of fine metal swarf based concrete paverblocks

S.No.	Percentage replacement of Fine Aggregate by wasteceramic tile	Mean Water Absorption %
1.	Conventional	3.01
2.	5 % Fine Metal swarf	3.27
3.	10 % Fine Metal swarf	3.65
4.	15 % Fine Metal swarf	3.96
5.	20 % Fine Metal swarf	4.19

PARTIAL REPLACEMENT OF FINE AGGREGATE BY CERAMIC TILE WASTE
Mean Compressive Strength after 7 Days of ceramic tile waste based concrete paver blocks

S.No.	Percentage replacement ofFine Aggregate by waste ceramic tile	Mean Compressive StrengthAfter 7 Days (N/mm^2)
1.	Conventional	22.93
2.	5 % ceramic tile waste	21.02
3.	10 % ceramic tile waste	20.17
4.	15 % ceramic tile waste	19.31
5.	20 % ceramic tile waste	16.03

Mean Compressive Strength after 14 Days of ceramic tile waste based concrete paver blocks

S.No.	Percentage replacement of Fine Aggregate by wasteceramic tile	Mean Compressive StrengthAfter 14 Days (N/mm^2)
1.	Conventional	31.12
2.	5 % ceramic tile waste	29.55
3.	10 % ceramic tile waste	28.37
4.	15 % ceramic tile waste	27.01
5.	20 % ceramic tile waste	23.89

Mean Compressive strength of ceramic tile waste based concrete paverblocks after 28 days

S.No.	Percentage replacement of Fine Aggregate by wasteceramic tile	Mean Compressive StrengthAfter 28 Days (N/mm^2)
1.	Conventional	34.202
2.	5 % ceramic tile waste	32.12
3.	10 % ceramic tile waste	31.01
4.	15 % ceramic tile waste	30.27
5.	20 % ceramic tile waste	27.11

Mean Water Absorption % of ceramic tile waste based concrete paver block

S.No.	Percentage replacement of Fine Aggregate by wasteceramic tile	Mean Water Absorption %
1.	Conventional	3.01
2.	5 % ceramic tile waste	3.87
3.	10 % ceramic tile waste	4.15
4.	15 % ceramic tile waste	4.93
5.	20 % ceramic tile waste	6.23

IV. CONCLUSION

For the present, experimental investigation has been on M-30-grade concrete pavers with the replacement of metal swarf and ceramic tile waste as fine aggregates in various percentages. After testing 160 concrete paver blocks with 5%, 10%, 15%, and 20% replacement of fine sand with metal swarf and ceramic tile waste, The results indicate that the compressive strength after 28 days of concrete paver blocks was increased a little by replacing metal swarf with 5% weight of fine sand, but the compressive strength after 28 days of concrete paver blocks decreased by 7-8% for 10%, 15%, and 20% replacement with metal swarf. Compressive strength after 28 days was decreased by replacing ceramic tile waste by 7–15% for 5%, 10%, 15%, and 20% replacement. Water absorption increases by approximately 10% for each 5% replacement of metal swarf, and water absorption increases drastically while replacing ceramic tile waste, i.e., around 100% for a 20% fine aggregate replacement with ceramic tile waste.

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