Study of strength properties using tile waste in concrete

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ABSTRACT- Quality aggregates have become scarce and costly in many places in India, due to sudden increase in construction activities required for the development of new infrastructure facilities. The use of waste materials in construction appears to be an attractive proposition. The reuse and recycling of these materials is still not a common practice especially in India, where most of the tile wastes produced is deposited in dumping ground. Use of recycled concrete aggregate and tile waste aggregate in lean concrete production helps in solving a vital environmental issue apart from being a solution to the problem of inadequate concrete Aggregates in concrete.

This study is bifurcated into two categories, which is cement optimisation and partial replacement of coarse aggregate by tile waste. In the optimisation part different trial mixes were casted by lowering cement content. These casted specimens were tested at end of curing of 7, 14, 28 days for compression, flexure and tension. The optimised cement content was considered and concrete was casted by partially replacing the coarse aggregate by tile waste.

Prime intention of this paper is well utilisation of scarce and quality aggregates by overcoming the problem of tile waste disposal.

I Introduction

Due to increased energy consumption and Carbon Di Oxide, there is a need of construction materials which consumes less energy and hence emits less Co_2. In this project we are making use of tiles waste as a replacement to coarse aggregate in different proportion. Our main aim is to make use of tile waste materials which is abundantly available from tile production factories and construction sites , which will save basic construction material and hence protect the environment not only in terms of conservation of energy but also to minimize the impact of mining.

Objectives

- Waste tiles utilization from production and construction sites.
- Impact of mining is minimized.
- Minimization in power consumption used for quarrying.
- Natural resources are conserved.

II. Materials used

Materials used in casting the concrete mould are having following properties:

Cement: ordinary Portland cement of 43 grade (J.K Cement) with specific gravity 3.06, available in local market.

a. *Fine aggregate,* ≤ 4.75mm and having specific gravity 2.606
b. *Coarse aggregate,* ≤ 20mm and having specific gravity 2.65
c. *Water:* water is an important constituent ingredient in concrete it actually participates in the chemical reaction with cement. Potable water should be used to mixing.

III Methodology

Work is divided into three phase.

Phase I; procurement of materials and its preparation

Phase II; Cement optimization

Phase III; Replacement of coarse aggregates by tile waste

Phase I; procurement of materials and its preparation

Waste tiles were broken to pieces and 20mm downsize pieces were collected after sieving. Aggregates and processed tile pieces were immersed in water for 24 hrs, prior to casting of concrete. (SSD)

Fig. 1-20mm downsize tile aggregate

Phase II

Cement optimization

Trial mix proportions were made and by varying cement content from 450, 425,400,375,350,320,315,310,305 to 300kg/m^3 with target strength of M25.

9 cubes, 1 cylinder, 1 beam each were casted for above mentioned trial mixes.

Tests were scheduled at the completion of curing of 7, 14, 28 days of curing.

Phase III

Replacement of coarse aggregates by tile waste

The trial mix with optimum cement value per m^3 was selected .

The same mix was casted by partially replacing coarse aggregate by tile waste from 0, 10, 20, 30, 40, 50, 60, 70, 80, 90 to 100% .

9 cubes, 1 cylinder, 1 beam each were casted for above mentioned trial mixes.

Tests were scheduled at the completion of curing of 7, 14, 28 days of curing.

IV. OUTPUT

Phase II -Cement Optimisation

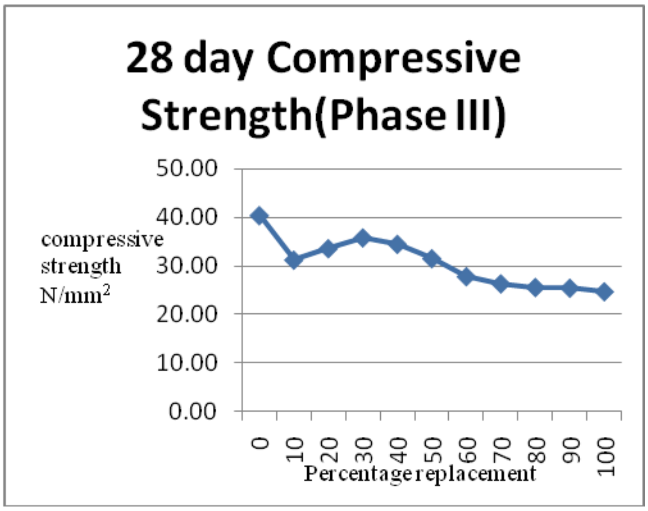
Cement content (kg/m^3)	7 day compressive strength(N/mm^2)	14 day compressive strength(N/mm^2)	28 day compressive strength(N/mm^2)	Flexural strength (N/mm^2)	Split tensile strength (N/mm^2)
450	20.74	27.85	30.67	3.67	3.07
425	32.44	43.70	48.00	5.75	4.8
400	34.96	46.96	51.70	6.16	5.17
375	32.00	42.96	47.26	5.81	4.73
350	31.56	42.37	46.52	5.69	4.66
320	31.26	42.07	46.07	5.57	4.61
315	30.96	41.78	45.63	5.51	4.56
310	30.81	41.33	45.48	5.51	4.54
305	30.67	41.04	45.19	5.45	4.52
300	30.37	40.44	44.89	5.39	4.25

Table. 1

Phase III-Aggregate replacement

Percentage replacement	07 day average compressive strength (N/mm^2)	14 day average compressive strength (N/mm^2)	28 day average compressive strength (N/mm^2)
0	30.37	40.44	44.89
10	23.26	31.26	34.37
20	25.04	33.63	36.89
30	26.67	35.85	39.56
40	25.33	34.52	37.78
50	23.41	31.56	34.52
60	20.44	27.85	30.22
70	19.41	26.37	28.89
80	18.96	25.63	28.59
90	18.52	25.48	27.41
100	18.22	24.74	26.96

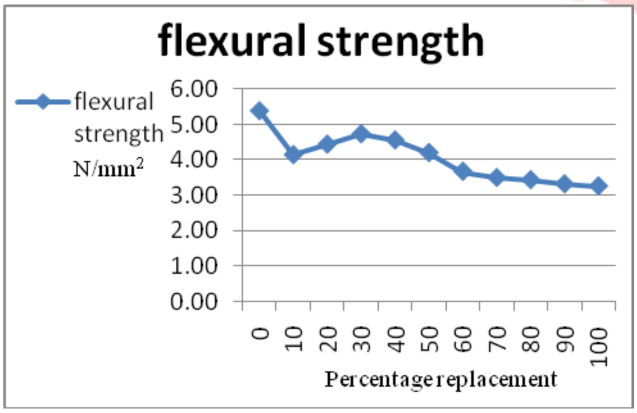
Table. 2



Graph-1

Percentage replacement	Flexural strength
0	5.39
10	4.15
20	4.44
30	4.74
40	4.56
50	4.21
60	3.67
70	3.50
80	3.44
90	3.32
100	3.26

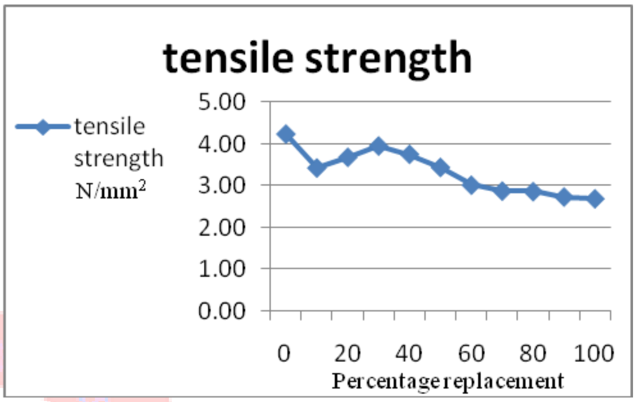
Table. 3



Graph-2

Percentage replacement	Tensile strength
0	4.25
10	3.44
20	3.69
30	3.96
40	3.77
50	3.45
60	3.03
70	2.89
80	2.87
90	2.75
100	2.70

Table. 3



Graph-3

Conclusion

The usage of waste tiles partially as a replacement for coarse aggregates will clear the wastes from construction and production site, also environmental pollution is reduced as impact of mining is reduced, natural resources are conserved and power consumption required for quarrying is minimised.

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