Study on use of Ground Granulated Blast Furnace Aggregate in Modelling of Rigid Pavement by using Kenpave Software

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Abstract— The comprehensive programme is taken up to study this ground granulated blast furnace aggregate used as a course aggregate in pavement concrete. In this, replacing the coarse aggregate to ground granulated blast furnace aggregate partially varying 0 to 50% and calculating maximum compressive strength and taking their corresponding Poisson's ratio and modulus of elasticity. Then inputting the value in kenpave software and analyze the stresses for different position like middle and interior, corner position and also vary thickness for single axle, two axle and three axle vehicle. In this study maximum compressive strength of concrete with 25% replacement of GGBF aggregate to coarse aggragte at 90 days is 64.2Mpa and 51.2Mpa at 28 days with 15% replacement of GGBF.
Keywords: corner position, kenpave software

I. INTRODUCTION

Concrete is an important material in the construction industry. Concrete demands massive amount to be produce to satisfy the current need. This quantity of concrete requires a quality raw material which produces concrete. The raw materials of concrete mainly natural products like aggregates, sand and cement. The natural raw material which produced concrete is day by day become scare. There is acute need of work out some other source and type of material which can be utilized for production of concrete with same outputs. Concrete is very complex material. In the advances in technology, one of the Concept is to use waste materials in the production of concrete. Blast furnace slag is one of them. In Rajkot city small industry is there. the most of the manufacturing works related to the steel, alloys and metals products and hence its produce large amount of by product. So this by product is create bad manner in atmosphere and also problem in dump of this material. So this product is use in concrete by replace of coarse aggregate by some percentage and decrease the cost of concrete.

II. LITERATURE REVIEW

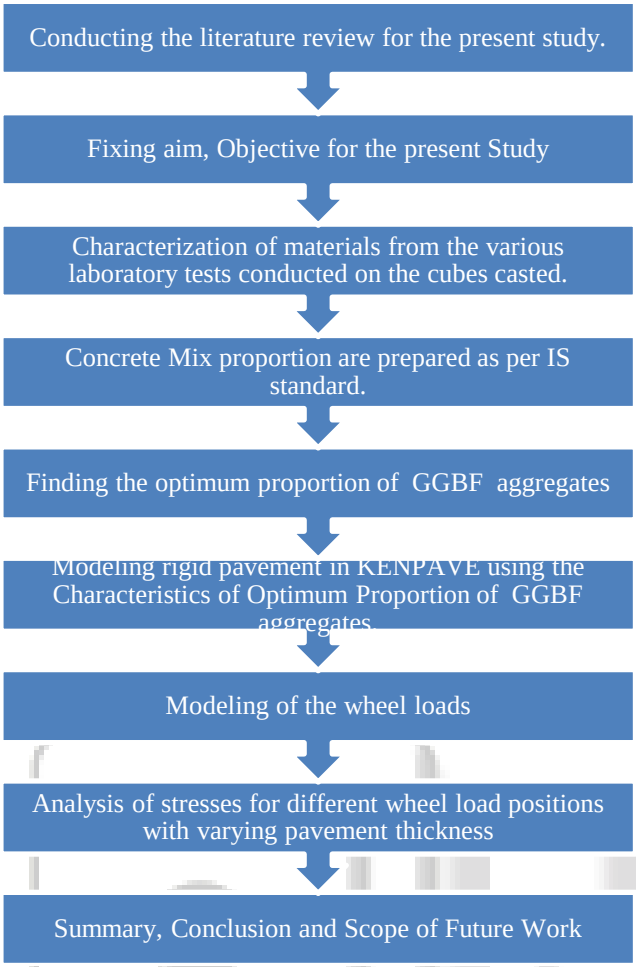
K.G. Hiraskar and Chetan Patil [1] In the present investigation Blast Furnace Slag from local industries has been utilized to find its suitability as a coarse aggregate in concrete making. Replacing all or some portion of natural aggregates with slag would lead to considerable environmental benefits. The results indicate that the unit weight of Blast Furnace Slag aggregate concrete is lower than that of the conventional concrete with stone chips. The experimental result show that replacing some percentage of natural aggregates by slag aggregates causes negligible degradation in strength. The compressive strength of Blast Furnace Slag aggregate concrete is found to be higher than that of conventional concrete at the age of 90 days. It has also reduced water absorption and porosity beyond 28 days in comparison to that of conventional concrete with stone chips used as coarse aggregate.

Dhanasri K, Kishore Kumar M [2] The present Investigation has been undertaken to study the effect of blast furnace slag and crusher dust on the mechanical properties of concrete, when coarse aggregates is replaced by blast furnace slag and crusher dust is replaced with fine aggregate in different percentages i.e. 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100%. The main parameters investigated were cube compressive strength, split tensile strength and flexural strength. The tests were conducted on concrete with Ratio 1:1.86:3.77.

Sanjay Kumar [3] The result of laboratory experiment carried out on concrete, with respect to designed M25 grade of concrete, produced from 15%, 30%, 45%, replacement of normal aggregate with blast furnace slag have been reported. The laboratory program included workability, compressive strength, split-tensile strength, flexural strength and elastic modulus of concrete. The result showed that concrete incorporating 30% fly ash and 30% blast furnace slag can be used for concrete pavement.

Mohammed Nadeem, Arun D. Pofale [4] These paper present results of experimental investigations carried out to evaluate effects of replacing aggregate (coarse and fine) with that of slag on various concrete properties. The basic objective of this study was to identify alternative source of good quality aggregates which is depleting very fast due to the fast pace of construction activities in India. In this study, concrete of M20, M30 and M40 grades were considered for a W/C ratio of 0.55, 0.45 and 0.40 respectively for the replacements of 0, 30, 50, 70 and 100% of aggregates (Coarse and Fine) by slag. Whole study was done in two phases, i.e. replacement of normal crushed coarse aggregate with crystallized slag and replacement of natural fine aggregate with granular slag. The investigation revealed improvement in compressive strength, split tensile and flexure strength over control mixes by 4 to 8 %. The replacement of 100 % slag aggregate (coarse) increased concrete density by about 5 to 7 % compared to control mix. Based on the overall observations, it could be recommended that slag could be effectively utilized as coarse and fine aggregates in all the concrete applications

III. METHODOLOGY



IV. RESULT

A. *Rigid pavement model in kenpave*

The rigid pavement is mainly for different load groups, thermal stress and load combinations. The modeled pavement for different load combinations at edge, center and corner are shown in figure1 to figure3

Thickness of slab in cm	Corner stress in Kpa	Edge stress in Kpa	Middle stress in Kpa
10	-42370.5	-10688.8	-5709.53
15	-26057.5	-6204.56	-3785.66
20	-17064.1	-3976.73	-2616.82
25	-11945.6	-2759.86	-1898.90
30	-8830.96	-2029.71	-1446.25
35	-6805.55	-1551.51	-1155.26
40	-5412.4	-1315.34	-953.68
45	-4406.46	-1185.23	-801.98
50	-3655.36	-1060.65	-682.82

Table 1: Stress result for dual wheel load for poisson's ratio 0.18:

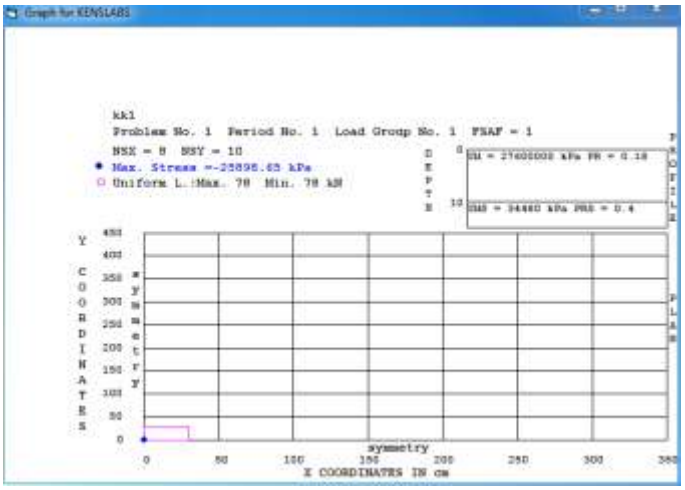


Fig.1: Rigid Pavement Model in KENPAVE for corner load

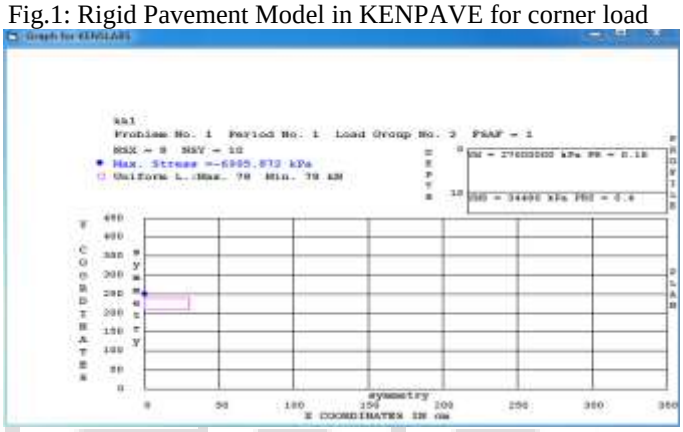


Fig.2: Rigid Pavement Model in KENPAVE for edge loading

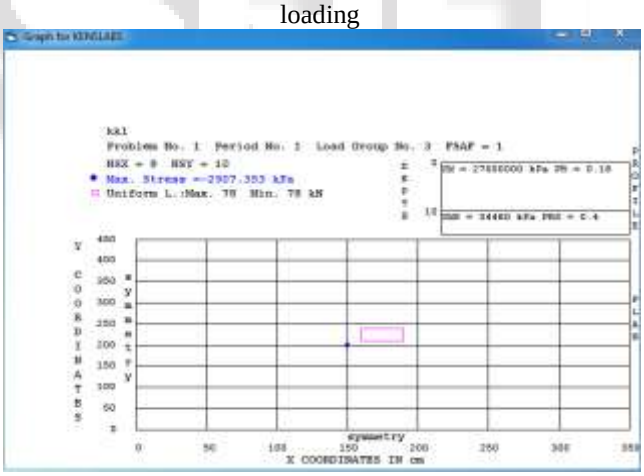


Fig.3: Rigid Pavement Model in KENPAVE for centre loading

B. *Analysis of rigid pavement models*

A detailed analysis was done on KENPAVE models for varying load groups and thickness. This was analyzed for different thickness and poisson's ratio. Table 1 to 3 and figure1 to 3 gives the summary of variation of edge, corner and centre stress for different load goups and thickness for poisson's ratio. The corner stress was found to increase with increase in pavement thickness.

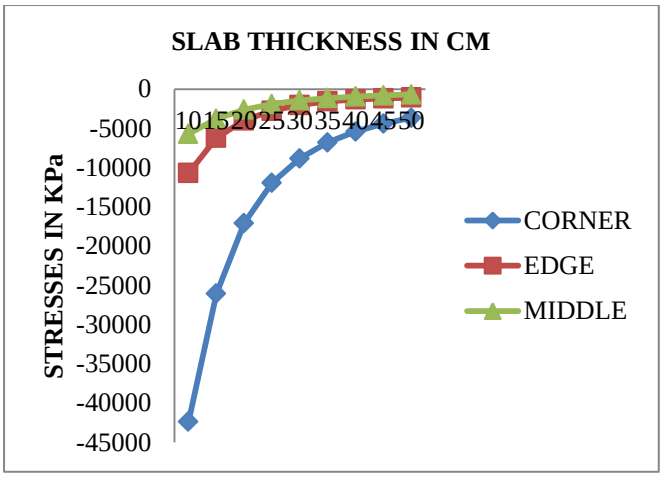


Fig.1: Thickness versus Stresses

Thickness of slab in cm	Corner stress in Kpa	Edge stress in Kpa	Middle stress in Kpa
10	-36653.3	-6892.55	-5761.61
15	-23713.5	-5995.97	-4493.84
20	-16253.3	-4846.89	-3405.18
25	-11815.3	-3879.34	-2654.68
30	-9022.17	-3171.49	-2145.07
35	-7147.43	-2854.51	-1782.25
40	-5817.70	-2601.18	-1507.76
45	-4824.79	-2348.93	-1289.29
50	-4062.00	-2104.96	-1110.71

Table 2: Stress result for two axel dual wheel load for poisson's ratio 0.18:

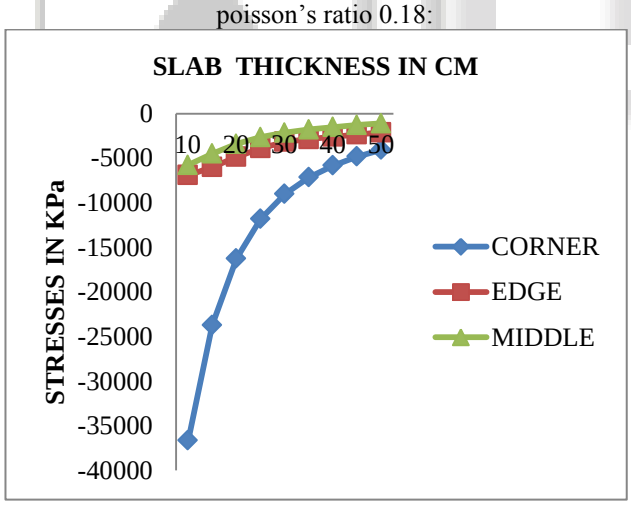


Fig.2: Thickness versus Stresses

Thickness of slab in cm	Corner stress in Kpa	Edge stress in Kpa	Middle stress in Kpa
10	-32392.8	-10518.4	-8196.1
15	-22051.2	-8849.20	-6355.7
20	-15741.2	-7100.31	-4831.1
25	-11825.2	-5677.29	-3784.9
30	-9283.98	-4771.46	-3073.9
35	-7526.65	-4360.83	-2565.4
40	-6243.58	-3964.89	-2177.8
45	-5254.708	-3574.455	-1866.9
50	-4475.019	-3199.667	-1612.1

Table 3: Stress result for three axel dual wheel load for poisson's ratio 0.18:

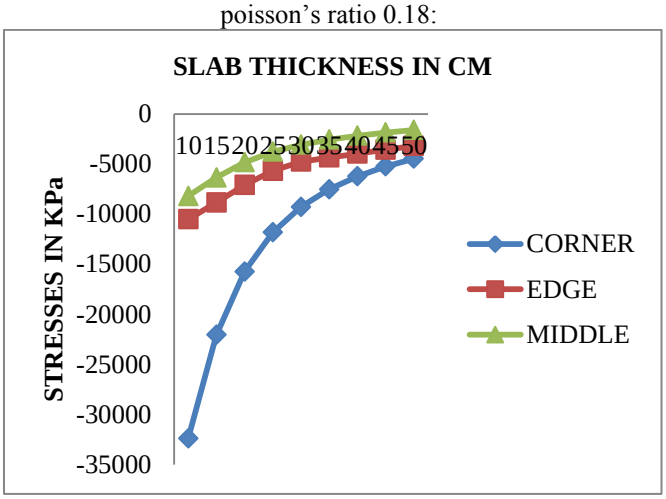


Fig.3: Thickness versus Stresses

V. CONCLUSION

A. Summary, limitations and scope for future studies

This study presents the results of an experimental and analytical work related with the failure and mechanical behavior of GGBF under different load condition. The particular type of GGBF considered here in is characterized by the partial replacement of natural coarse aggregates by GGBF. The aim of this research is to deepen the existing knowledge related to GGBF by analyzing the degradation in physical and mechanical properties when GGBF coarse aggregates are used. Eleven different mixes of recycled aggregates (0 to 50 %) was used to find the optimum GGBF aggregate content. It was found that 28 days characteristic strength was found maximum for 15 % replacement of normal aggregates.

A rigid pavement was modeled on KENPAVE using the characteristics value obtained from experimental results. This was analysed for different load groups, thermal loads and load combinations. The results from the analysis are explained in the following paragraphs.

With respect to poisson's ratio a slight change in stress was observed for a given load group. Corner stress was found to increase with thickness of slab. Comparing with different load group load group D creates more stresses compared to other load groups

B. Limitations and scope for future studies

- The study is limited to plain cement concrete pavements only. This can be further extended to Reinforced concrete pavements and pre stressed concrete pavements.
- The effect of dynamic load is not considered in the present study.

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