A CASE STUDY ON THE USE OF GRADED GRAVEL SOILS-BOTTOMASH/FLYASH MIXES AS BASE AND SUB-BASE COURSE MATERIALS

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ABSTRACT

Flexible pavements are widely used road network and made up of locally available naturally soils. Most of the soils are failed to meet the requirements of standard specifications. Scarcity of soil which suits for construction activities by fulfilling geotechnical characteristics is forcing the pavementengineers to look for alternative materials. On the other hand, rapid industrialization generates huge quantities of industrial wastes and their disposal becomes a big task. bottom ash is obtained from thermalpower plants.

Key words: Bottom ash, fly ash, gravel soil, bearing strength.

INTRODUCTION

Industrialization now a day's leads to the development of infrastructure. Due to this development, it is becoming one of the major sources of income to the country. Road networking or construction of pavement is also infrastructural facility which was rapidly increasing in this generation. So now a day they look forward to use an alternative material instead of natural materials in order to reduce the scarcity of the soil. Gravel soils are promising construction material in civil engineering structures such as road, embankments and fill material due to their inherent characteristics. Presence of wide range of particles varying sizes from 75mm to particles less than 2μm help these soils into compacted and dense conditions which helps to get high strengths under loading. Sometimes excess fine-grained particles especially fines i.e. silt and clay particles can take excess moisture and make thesegravel soils highly deformable under loading and deteriorates the strength of gravel soils on saturation. To arrest these plastic deformations, stabilization technique can be proposed. Hence the search for new alternative materials with improved techniques to process the local material has received an enhanced importance across the globe.

Introduction of industrial wastes in highway projects implies eco-friendly construction of roads with the usage of available alternate waste materials which provides the solution for the unique question of non-decaying waste disposal which in turn poses a serious problem for the natural environment. Hence extensive research has been carried out by various researchers on industrial wastes like crusher dust, bottom ash, fly ash and pond ash etc.

MATERIALS USED

GRAVEL:

Gravel is composed of unconsolidated rock fragments that have a general particle size range and include size classes from granule- to boulder sized fragments. Gravel is an important commercial product, with a number of applications. Many roadways are surfaced with gravel, especially in rural areas where there is little traffic. Globally, far more roads are surfaced with gravel than with concrete or Russia alone has over 400,000 km (250,000 mi) of gravel roads. Both sand and small gravel are alsoimportant for the manufacture of roads.

BOTTOM ASH:

Bottom ash is part of the non-combustible residue during combustion in a furnace or incinerator in an industrial context, it is usually refers to coal combustion and comprises traces of combustibles embedded in forming clinkers and sticking to hot side walls of a coal- burning furnace during its operation. The portion of the ash that escapes up the chimney or stack is however, referred to as fly ash.

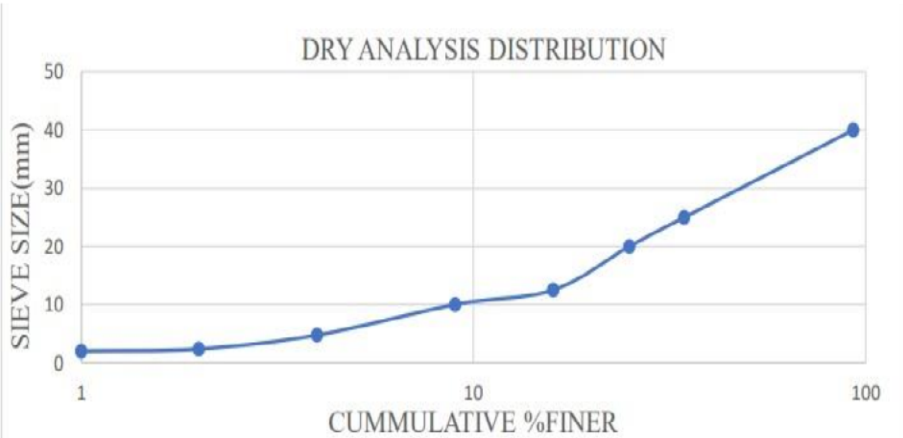
FLY ASH:

Fly ash is a fine powder that is a by-product of burning pulverized coal in electric generation power plants. Fly ash is a pozzolanic substance which contains aluminous and siliceous material that forms cement in the presence of water. When mixed with lime and water, fly ash forms a compound similar to Portland cement.

EXPERIMENTAL STUDY

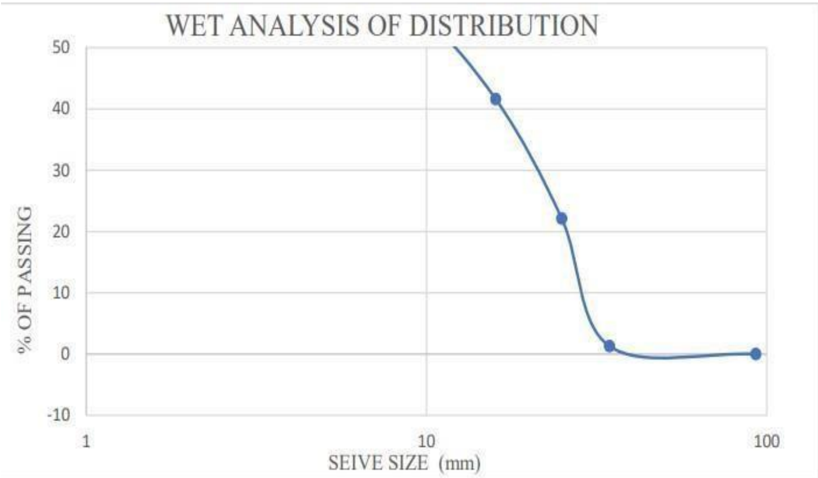
DRY ANALYSIS:

IS sieve(mm)	Weight ofretained (grams)	Cumulativeretained for each sieve(grams)	% Cumulative retained foreach sieve	%of finer
40	70	70	7	93
25	585	655	65.5	34.5
20	95	750	75	25
12.5	90	840	84	16
10	70	910	91	9
4.75	50	960	96	4
2.36	20	980	98	2
2.00	10	90	99	1
pan	10	1000	100	0



WET ANALYSIS:

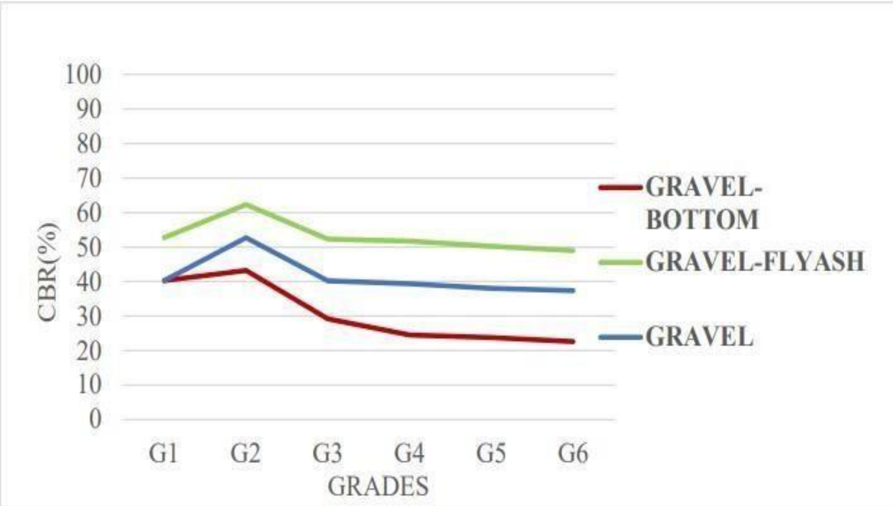
IS sieve(mm)	Weight ofretained (grams)	Cumulativeretained for each sieve(grams)	% Cumulative retained foreach sieve	% offiner
4.75	50	50	6.49	93.51
2.36	55	105	13.36	86.37
2.00	60	165	21.42	78.58
0.6	65	230	29.87	70.13
0.425	100	330	42.85	57.15
0.3	120	450	58.44	41.56
0.15	150	600	77.92	22.08
0.075	160	760	98.70	1.3
pan	10	770	100	0

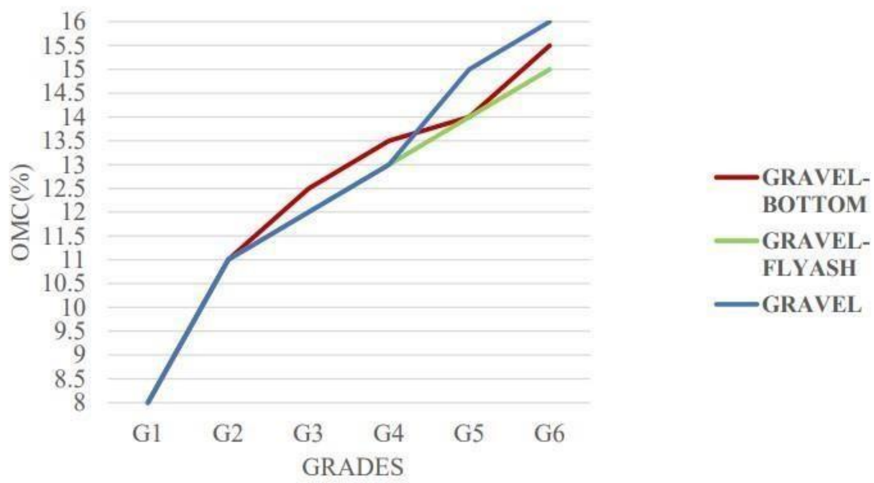


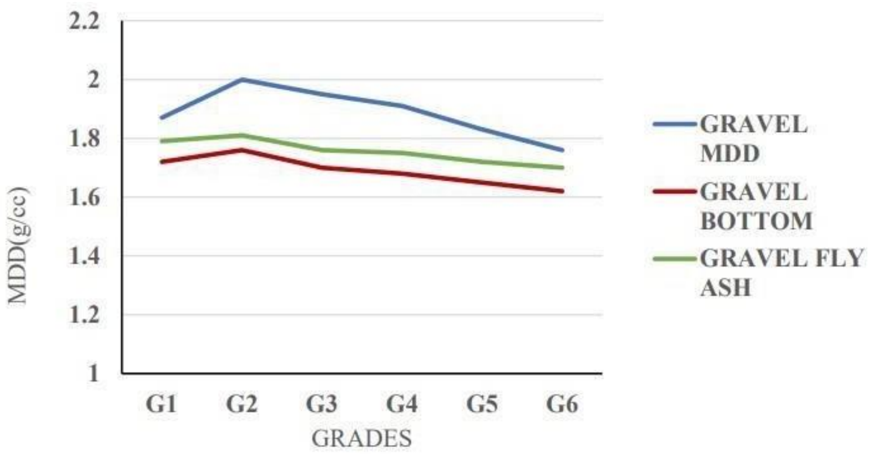
SPECIFIC GRAVITY:

S.no	Description	Trail-1(grams)	Trail-2(grams)
1	Weight of pycnometer(w1)	600	600
2	Weight of pycnometer +Dry Soil (w2)	910	900
3	Weight of pycnometer +Drysoil +Water (w3)	1640	1630
4	Weight of pycnometer +Water(w4)	1440	1440
5	Specific gravity of gravel	2.8	2.7

COMPARISION OF RESULTS BETWEEN GRADED GRAVEL SOIL, GRADED GRAVEL – BOTTOM ASH/FLYASH:







CONCLUSION

- Graded gravel soils (G1, G2, G3, G4, G5, G6) have attained maximum dry densities in the range of 1.76 g/cc to 2.00 g/cc and their corresponding CBR values in the range of 37.4 to 52.7.
- Mixes of graded gravel soil with partial replacement of fly ash (GF1 to GF6) have attained maximum dry densities in the range of 1.70 g/cc to 1.81g/cc and their corresponding CBR values in the range of49.0 to 62.3.
- Mixes of graded gravel soil with partial replacement of bottom ash (GB1 to GB6) have attained maximum dry densities in the range of 1.62 g/cc to 1.76 g/cc and their corresponding CBR values in the range of 32.6 to 43.2.
- Test results of graded gravel soils show that increasing the percentage of gravel particles (> 4.75mm)increases maximum dry density (MDD) values and decreases optimum moisture content (OMC) values, it is also vice-versa with respect to particles less than 4.75mm. The corresponding range of MDD values is 1.76g/cc to 2.00 g/cc and OMC values is 8 to 16 %.
- Test results of graded gravel – bottom ash mixes show that increasing the percentage of bottom ash decreases maximum dry density up to 1.62g/cc to 1.76g/cc. Decrease in maximum dry density value is due to involvement of more bottom ash particles w.r.t gravel particles lead to compacted and cohesive matrix.
- It is also seen that CBR values of graded gravels soils are in the range of 37.4 to 40.3. Graded soils G1,G2,G3,G4,G5 and G6 have CBR values greater than 30 are dominated by coarser particles and thevariations in CBR values is due to deformation of finer particles in saturated conditions under loading.Gravel soils having CBR values greater than 30 can be used as sub-base course with mechanical modifications.
- It is also seen that CBR values of graded gravel-bottom ash mixes are in the range of 32.6% to 43.2%. Graded soils GB1,GB2,GB3,GB4,GB5 and GB6 have CBR values greater than 30 are dominated by coarser particles and the variations in CBR values is due to deformation of finer particles in saturated conditions under loading. Gravel soils having CBR values greater than 30 can be used as sub-base course with mechanical modifications.
- It is also seen that CBR values of graded gravel-fly ash mixes are in the range of 49.0 to 62.3. Graded soils-fly ash GF1,GF2,GF3,GF4, GF5, and GF6 have CBR values greater than 30 are dominated by coarser particles and the variations in CBR values is due to deformation of finer particles in saturated conditions under loading. Gravel soil-fly ash mixes having CBR values greater than 30 can be used assub-base course with mechanical modifications.

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LIST OF I.S CODE RECOMMENDATIONS

• IS :2720 (part IV) -1985 for dry analysis and wet analysis

• IS :2720 (part III/ section 1)-1980 for fine grained material of specific gravity.

• IS :2720 (part III/ section 2) -1980 for coarse grained material of specific gravity.

• IS :2369 (part III)1963 specific gravity by using glass vessel.

• IS :2720 (part VIII) - 1983 for heavy compaction test.

• IS :2720 (part XVI) -1987 for CBR