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Effect of Gradation and Plasticity on Compaction Characteristics of Red Gravel Soils

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ABSTRACT:
Red gravel soils are widely distributed over the north coastal districts of Andhra Pradesh. These soils are highly desirable for construction activities due to their inherent advantages. To use these soils in various Geotechnical engineering applications it is necessary to understand their behaviour with respect to its composition. In the present investigation gravel soil samples have been verified for geotechnical characterization and their suitability is studied with respect to gradation, plasticity and compaction characterization to use as fill material, embankment material and road component layers etc.

Keywords: characterization, composition, Gravel soil,

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I. INTRODUCTION:

Civil engineering projects require strong and durable bases for distribution loads to the sub-surfaces the founding layers are strong enough to digest these loads with giving excess shear deformations. In this connection soils possessing the above characteristics are desirable among these gravels soils prominent. The performance of gravel soil layers with respect to various geotechnical functions depend on their composition such as grain size distribution, percentage of fines and their allied characteristics such as plasticity, compaction and strength etc.

A limited Research has been carried on Red gravel soils, i.e Priyani(1958) reported that locally available coarse grained soils, murrum are commonly used as sub-base and base course materials. Gourely (1997) studied case of laterite gravels as base course material in South African roads. Nunan.T. (1990) studied improved gravels for construction. Ramana Murthy.V. (2003) studied use of morrum in pavement construction. Omar .M (2003) studied compaction characteristics of coarse grained soils. Pradeep Muley(2010) studied utilization of murrum for hard shoulder material. MORTH(2012) specified that gravel soils low plasticity characteristics can have wide application in road construction. Rehman.Z.U (2017) studied coarse grained soil for compaction, gradation and CBR values. Patel A.K.(2013) studied CBR characteristics of SC soils. NCHRP (2001) studied compaction, CBR, plasticity characteristics. Satyanarayana et.al (2013) studied high plastic gravels and their stabilized materials can be used as sub-base courses in pavement construction

In the present investigation 28 no. of gravel soils have been studied with respect to various geotechnical characteristics and their suitability can be evaluated based on the results.

II. MATERIALS:

In the present study 28 gravel soil samples were collected from different locations of North Coastal districts of Andhra Pradesh at a depth of 1.5m from the Ground Surface out of which 16 soil samples are gravel fraction (>4.75mm) dominating soil and 12 soil samples are sand fraction (4.75-0.075 mm) dominating soil. These gravel soil samples were tested for the grain size Distribution (IS: 2720-Part-4-1985), plasticity characteristics (IS: 2720-Part-5-1985), Compaction Characteristics (IS: 2720-Part-8-1983) and CBR values (IS: 2720-Part-16-1974). These characteristics are analysed and suitable Identifications are made.

III. TESTS AND RESULTS:

3.1) Grain size distributions (IS: 2720-Part-4-1985):

A known quantity of dried soil mass was washed through 75µ m sieve and the fine particles can be subjected for sedimentation analysis (Hydrometer method) and coarser portion was dried and subjected for sieve analysis. Based on the above test data grain size distribution was generated and the results are shown in table 1 and 2.

3.2) Plasticity characteristics (IS: 2720-Part-5-1985):

Dried soil sample passing through 425 µ m sieve subjected for liquid limit (W_L) using Casagrande method (IS: 2720-Part-5-1985), and Plastic limit (W_P) and Plasticity Index, (I_P)as difference of these two (W_L-W_P) and the results are shown in table 1&2.

3.3) Compaction characteristics (IS: 2720-Part-8-1983):

Modified proctor tests were performed on oven dried soil samples by performing 5 layers with 25

blows for each with a Rammer of 4.89kg and the results are shown in table 1&2.

IV. RESULTS AND DISCUSSIONS:

4.1 Geotechnical characterization of Red gravel soils:

Results based on the test conducted as mentioned above with respect to IS 2720 are shown below table 1 & 2 and their characterization described**.**

Table 1: Geotechnical properties of Gravel soils dominated by Gravel fraction

Properties / Location	G (%)	S (%)	F (%)	Silt (%)	Clay (%)	W_L (%)	W_P (%)	I_P (%)	OMC (%)	MDD (g/cc)	IS
Etcherla	53	31	16	12	4	26	19	7	8.8	2.12	GC
Narasannapeta	38	32	30	20	10	38	21	17	11.0	2.05	GC
Pithapuram	48	39	23	16	7	26	18	8	8.8	2.10	GC
Tekkali	38	30	32	22	10	30	20	10	10.5	2.07	GC
Vizag (APSEB)	54	28	18	12	6	28	19	9	9.0	2.08	GC
Dasannapeta	50	29	26	12	9	40	21	19	11.2	2.05	GC
Bhogapuram	46	30	24	16	8	30	20	10	10.0	2.07	GC
Pydi bhimavaram	38	34	28	20	8	27	18	9	10.0	2.08	GC
Yendada	42	23	35	20	13	35	20	15	10.5	2.08	GC
Duvvada	56	26	18	10	8	40	22	18	11.0	2.07	GC
Seethammadhara	67	14	19	12	7	30	20	10	10.0	2.12	GC
Autonagar	52	30	18	12	6	28	19	9	8.5	2.11	GC
MMTC	56	28	16	10	6	26	18	8	8.6	2.12	GC
Madhurawada	60	26	14	10	4	25	18	7	8.2	2.13	GC
Lankelapalem	40	32	28	18	10	27	19	8	9.3	2.08	GC
Parawada	46	30	24	16	8	26	18	8	9.0	2.07	GC

Table 2: Geotechnical properties of Gravel soils dominated by Sand fraction

Properties / Location	G (%)	S (%)	F (%)	Silt (%)	Clay (%)	W_L (%)	W_P (%)	I_P (%)	OMC (%)	MDD (g/cc)	IS
Srikakulam	29	46	25	16	9	32	19	13	10.7	2.06	SC
Kota bommali	26	50	24	12	12	39	20	19	11.2	2.04	SC
Gajapathinagaram	34	38	28	18	10	34	20	14	10.6	2.05	SC
Jonnada	32	38	30	20	10	29	19	10	10.3	2.07	SC
Gantthiram	28	48	24	15	9	32	19	13	10	2.06	SC
Grey hounds	22	52	26	16	10	32	20	12	10.2	2.06	SC
Gajuwaka	26	50	24	14	10	38	21	17	10.5	2.04	SC
Rayavaram	30	48	22	14	8	31	19	12	9	2.06	SC
Tuhpalamma lova	35	40	25	15	10	30	20	10	9	2.06	SC
Murari	32	44	24	16	8	29	19	9	9.2	2.06	SC
Gollapalli	25	43	32	20	12	33	20	13	9.5	2.05	SC
Rajanagaram	36	42	22	14	8	30	19	11	8.8	2.07	SC

G:Gravel, S:Sand, F:Fines, W_L: Liquid limit, Wp: Plastic limit, I_P: Plasticity Index, OMC: Optimum Moisture Content, MDD: Maximum dry density, CBR: California bearing ratio, IS: Indian standard classification.

Red gravel soils of north coastal districts of Andhra Pradesh are dominated by gravel fraction have gravel particles in the range of 38-67% , sand particles 14-39% and fines are in the range of 14-32% respectively and it is also seen these gravels have a wide range of particles. Where as Red gravel soils dominated by sand fraction have gravel particles in the range of 22-36% , sand particles 38-52% and fines are in the range of 22-32% respectively . From the grain size distribution it is identified that sand dominating soils have more number of fine particles and less number of gravel particles than gravel fraction dominating gravel soils.

Gravel fraction dominating gravel soils having liquid limit in the range of 25-40% and Plasticity Index range of 7-17% , where as sand fraction dominating gravel soils having liquid limit in the range of 29-33% and plasticity index in the range of 9-19% . Soil with high percentage of fines exhibited high Liquid Limit and Plasticity Index values. From the compaction characteristics it is identified that there soil having OMC is in the range of 8.2-11% and MDD 2.05-2.13g/cc. Gravel fraction dominating gravel soils having CBR values are in the range of 21-38%, and sand fraction dominating gravel soils CBR values in the range of 16-24%.

4.2 Compaction characteristics of red gravel soils:

Test results of 28 gravel soils from North Coastal Districts of Andhra Pradesh, the following identifications are made.

- Increase in the percentage gravel particles increases MDD values and decreases OMC values whereas increase in the percentage of sand particles decreases MDD values and increase OMC values.
- Increase in the percentage of fines increases the liquid limit and plastic limit values there by increases plasticity index values which increases OMC values and decreases MDD values.
- Domination of single size particles either gravel or sand increases OMC values and decreases MDD values.
- Combination of gravel and sand particles with less percentage of fines exhibited high density, high MDD and low OMC values.
- Gravel soils dominated by single size particles makes the soil matrix to poorly graded which leads to honeycombing structure where as gravel soils representing maximum no. of particles i.e gravel particles, sand and fine particles exhibit well graded condition give cohesive matrix resulting dense condition.

- Increase in the percentage of fines (silt and clay particles) increase the specific surface which require more water to lubricate the particles for attaining the effective condition increases OMC values. Similarly representation of more no. of particles (wide range of particles) leads to well graded condition which helps in filling of voids and increases the requirement of water and increases interlocking of particles. Therefore increase the requirement of more water leads to high OMC values and represent more no. of solids in a given volume tends to high densities compared to single size particles i.e poorly graded soils with their honey combing structures.

V. APPLICATIONS:

Gravel soils are naturally occurring soils with high densities can have wide applications in geotechnical and civil engineering constructions.

- Fill materials for foundations under spread footings.
- Backfill material for retaining walls
- Cohesive frictional backfill materials for Reinforce Earth Retaining Walls
- Surcharge material for preloading technique in case of soft clays.
- Cushion material in expansive soils
- Artificial soil pads for spreading heavy loads
- Subgrade and sub-base materials in road works
- As embankment material for roads and railway tracks.

VI. CONCLUSIONS:

Gravel soils are naturally occurring soils with wide range of particles possess high strength, high densities, non-swelling and incompressible characteristics help the structures free from excess shear deformations when they used as construction material in geotechnical engineering applications.

REFERENCES:

[1]. Gourley C.S. and Greening, P.A.K. (1997) , " Use of Sub-standard Laterite Gravels as Road Base Materials in Southern Africa", International Symposium on Thin Pavements, Surface Treatments and Unbound Roads, University of New Brunswick, Canada.

[2]. Ministry of surface transport MORTH, clause N0.500-2001

[3]. Nunan, T.A and Humphrey D.N(1990), " A Review and Experimentation of Gravel Stabilization methods, executive", Technical services division, Technical report 90-2, Departments of Civil Engineering, University of Maine, Orono, Maine.

[4]. NCHRP. (2003). Guide for Mechanic – empirical design of new and rehabilitated pavement structures. National Co-operative Highway Research Program Transportation Research Board National Research Council, Illinois 61820.

[5]. Omar, M., Abdallah, S., Adnan Basma and Samer Bakarat (2003), " Compaction characteristics of granular soils in United Arab Emirates", Geotechnical and Geological Engineering 21: 283-295, 2003.

[6]. Priyani, V.B. (1958) : Road engineering, Second Edition, Charotar Book stall

[7]. Pradeep Muley, Jain P.K (2010), " Experimental studies on utilization of morrum as hard shoulder material", International Journal of engineering Science and technology. Vol. 2(9), 2010, p. no. 4896-4901.

[8]. Patel, A.K., Sathawara Jigar K. (2013), " Comparision between soaked and unsoaked CBR", International journal of Advanced engineering research and studies, Vol II, Issue III, p-132 to 135.

[9]. Ramana Murthy, V. and Hari Krishna, P. (2003): Influence of Inorganic Additives on Properties of Morrum Soils Used in Pavement Construction, National seminar on Recent Advances in Civil Engineering, KITS – Warangal, pp. II 17-II 23.

[10]. Rehman Z.U, Khalid U, Farooq K, Mujtaba H (2017), " Prediction of CBR values from Index properties of different soils", Technical journal university of engineering and technology Taxila, Pakistan, Vol. 22 No.II-2017, p-17 to 26.

[11]. Satyanarayana, P.V.V, Raghu P, Ashok Kumar R, Pradeep N (2013), " Performance of Crusher Dust in High plastic gravels as road construction material", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), vol.10, pp:1-5

[12]. Satyanarayana, P.V.V, Raghu P, Ashok Kumar R, Pradeep N (2013), " Utilization of Crusher dust Stabilized Gravels as Sub-base materials", International Journal of Engineering Research and Technology (IJERT), vol-2, Issue 11. Pp:4034-4046

[13]. IS 2720 Part XIII 1985 Direct Shear Test

[14]. IS 2720:Part 4: 1985 Methods of Test for Soils-Part 4:Grain Sieve Analysis

[15]. IS 2720: Part 16 : 1987 Methods of Test for Soil-Part 16: Laboratory Determination of CBR

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