REPORT ON TESTING OF CONSTRUCTION & DEMOLITION WASTE

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EXECUTIVE SUMMARY

A laboratory study was performed to assess the geotechnical parameters of Construction and Demolition Waste ("CDW"). Different sample were prepared and tested for geotechnical characteristics. The soil index properties, moisture content, permeability, dry compressibility, consolidation, compaction, and strength were evaluated.

Based on the results of this study, it can be concluded that the CDW has similar engineering properties to those of the dredged materials. The final compacted material is compactable on a wide range of water content (12-20%). It is slightly difficult to compact owing to a narrow range of maximum and minimum void ratio.

Structurally, the strength of CDW is reduced with the addition of water. However, this reduction is not significant for normal structural applications in roads where interpretation from CBR test may provide more valuable inferences. The permeability of the CDW media is high, thereby making it more suitable for structural fills. Compaction, consolidation, and compressibility of the CDW are similar to those of the medium to fine sands with some strange morphological dissimilarity. To capture the behavior of CDW for a wide range of applications there is a need of intensive characterization of this material.

INTRODUCTION

The testing for the two of samples as provided by Ecosmart Ltd from C&D waste of sites located at Sarai and Rohtak was performed as per the procedures and practice laid down in relevant practice Codes of the Bureau of Indian Standards. The list of the tests required to be conducted is given below:

S. No.	Tests Performed
1	Gradation Analysis
2	Specific Gravity
3	Relative Density
4	Sedimentation Analysis
5	Compressibility by Oedometer (Possible maximum & minimum void ratio)
6	Permeability
7	Shear Tests in Saturated and Dry Conditions
8	CBR test (Soaked and Unsoaked conditions)
9	Standard Proctor Compaction Test
10	Consolidated Test

RESULTS

1. Gradation Analysis and Sedimentation Analysis

The grain size distribution curves are presented in **Fig. 1** & **Fig. 2,** and the results from gradation analysis are presented in **Table 1.** The fraction of soil particles finer than 75 micron is less than 8% by weight soil mass in both the cases. The sedimentation analysis indicated that the material contains no clay fraction. As per the classification of soils it may be indexed as SW-SP.

Table.1: Results of Gradation Analysis

CD Sample	D_{60}(mm)	D_{30}(mm)	D_{10}(mm)	Cu	Cc
Sarai	0.5601	0.2125	0.076	7.099	0.9414
Rohtak	0.4996	0.1927	0.08	6.245	1.076

2. Specific Gravity, Standard Proctor Compaction and Relative Density Tests

The results of these tests are presented in **Table 2.** Also, the Standard Proctor Compaction curve showing the relationship between moulding moisture content and corresponding dry density is presented in **Fig. 3.**

Table.2: Results of Specific Gravity, Standard Proctor Compaction and Relative Density Tests

CD Sample	Specific Gravity, (G)	Standard Proctor Compaction		Maximum & Minimum Density (g/cc)	
		Max. Dry Density (g/cc)	OMC (%)	Max (Vibration)	Min (Slow pouring)
Sarai sample	2.483	1.70	21.73	1.724	1.426
Rohtak sample	2.478	1.558	20.71	1.694	1.397

3. Permeability and CBR Tests

The tests were conducted at maximum dry density and optimum moisture content. The results of permeability and CBR tests are presented in **Table 3.** The CDW has shown drainage characteristics similar to a free draining material when tested at Proctor density. As per the requirements for compactions and slopes of highway embankments based on CBR values for soils it may be classified as A4-A5 type.

Table.3: Results of Permeability and CBR Tests

CD Sample	Permeability (cm/sec)	CBR (%)	
		Soaked	Unsoaked
Sarai sample	2.93×10^{-2}	8.99	9.42
Rohtak sample	4.61×10^{-2}	13.48	18.19

4. Shear Strength

The direct shear tests were conducted at maximum relative density of 80% that could be maintained in saturated and dry conditions. As anticipated in a soil containing dust, the dry strength is higher than that of saturated CDW. The cohesion was found to be absent in both the cases. The results are presented in **Table 4.**

Table.4: Results of Shear Strength Tests

CD Sample	Relative Density	Saturated Condition		Dry Condition	
		c (kPa)	ϕ°	c (kPa)	ϕ°
Sarai sample	80%	0	28.35	0	36.08
Rohtak sample	80%	0	32.41	0	38.05

5. Consolidation and Compressibility

Consolidation and compressibility tests were conducted in 60 mm diameter and 20 mm thickness cylindrical specimen in Oedometer. As anticipated in a soil containing dust the dry compression index is lower than compression index of saturated CDW. The tests were conducted on maximum and minimum relative densities that were easily maintained in the sampler. The results are presented in **Table.5**

Table.5: Results of Consolidation and Compressibility Tests

CD Sample	Relative Density	Compression Index Saturated Condition	Compression Index Dry Condition
		C_c	C_c
Sarai sample	20%	0.0576	0.046
	50%	0.0538	0.0454
Rohtak sample	20%	0.0606	0.0483
	50%	0.0517	0.0413

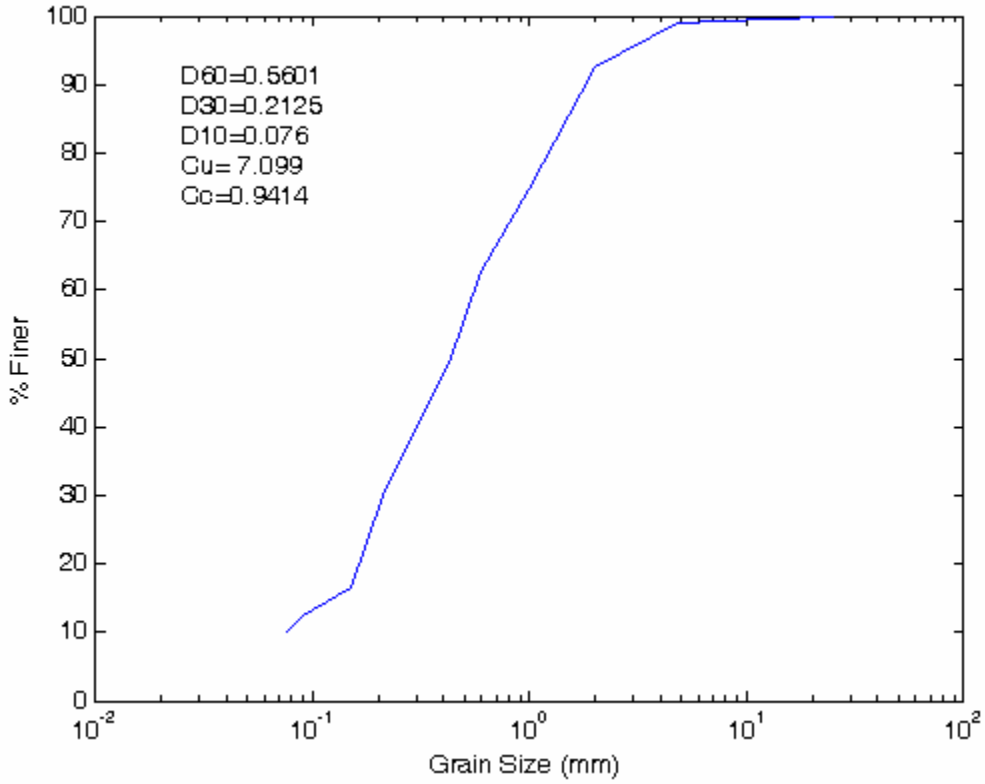

Fig.1 Grain Size Distribution of Sarai Sample

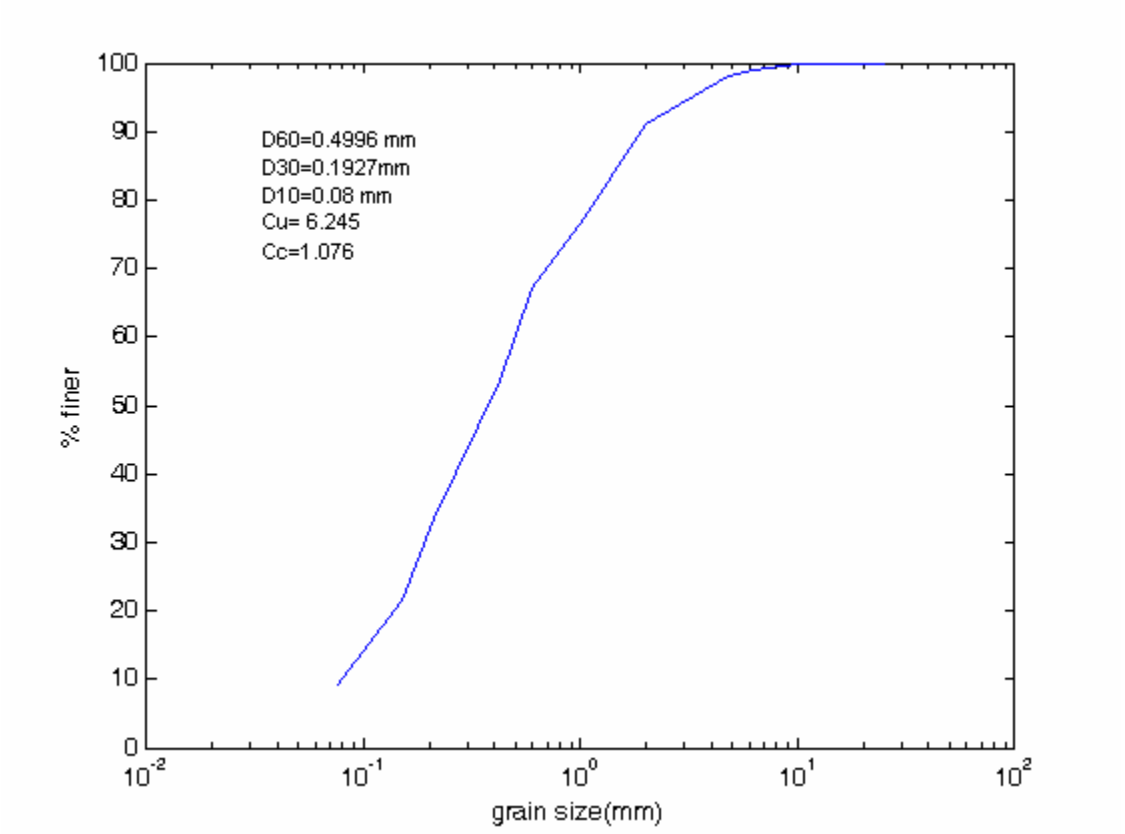

Fig. 2 Grain Size Distribution of Rohtak Sample

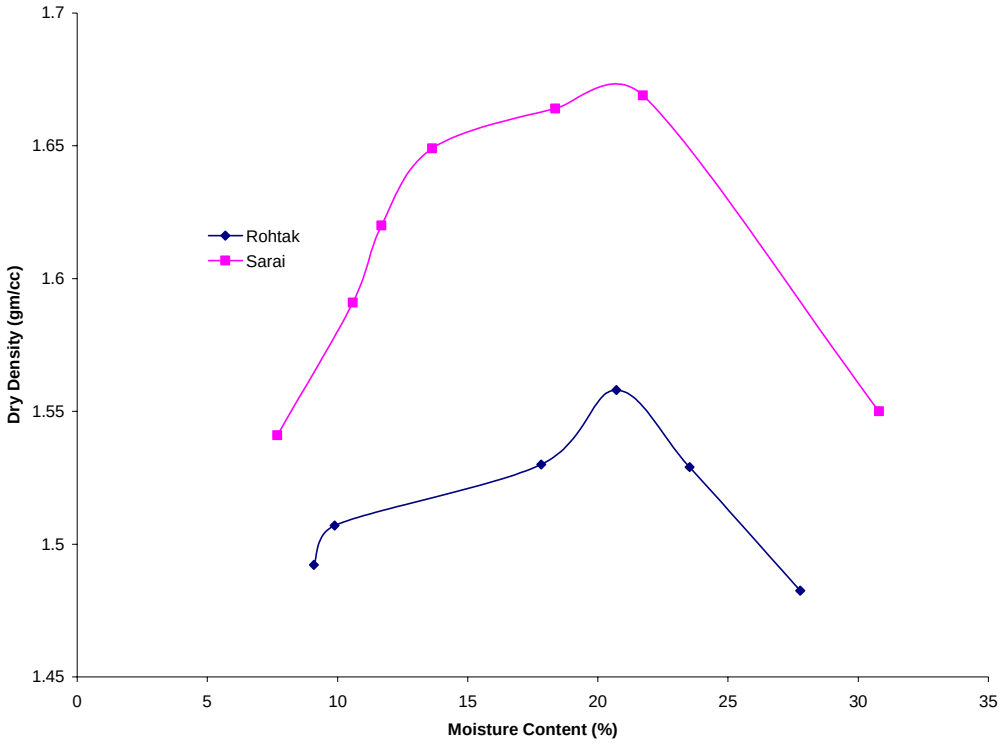

Fig. 3 Standard Proctor Compaction Plot for Rohtak and Sarai Samples

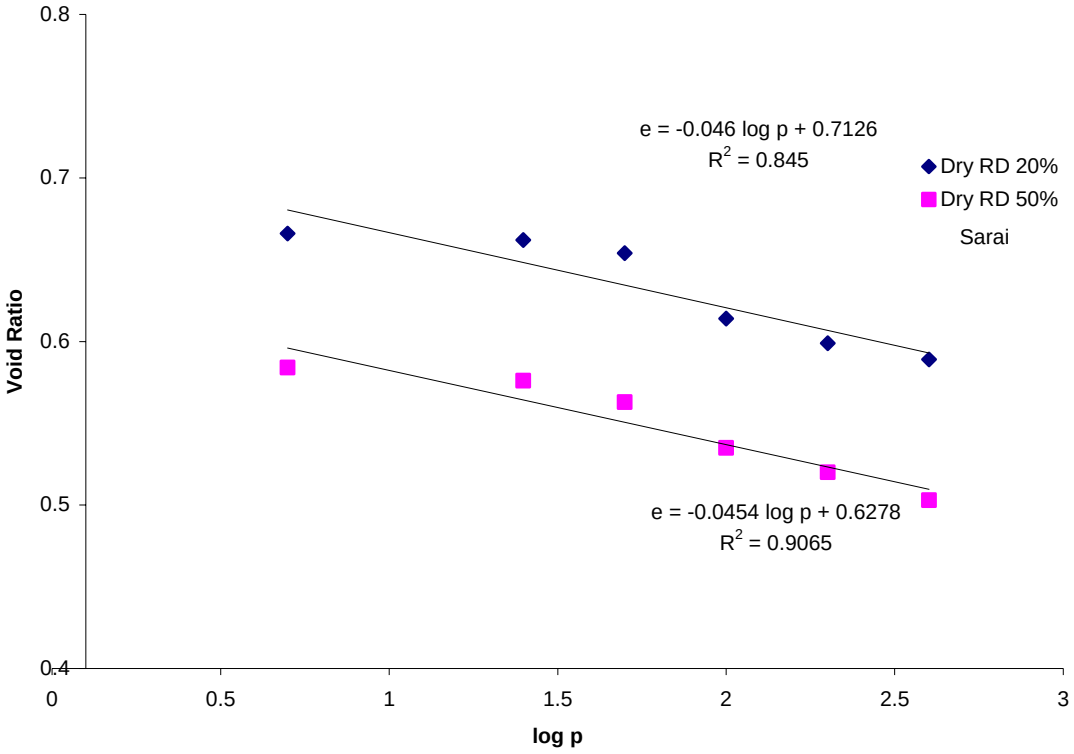

Fig. 4 Compressibility of Un-soaked Sample (Sarai)

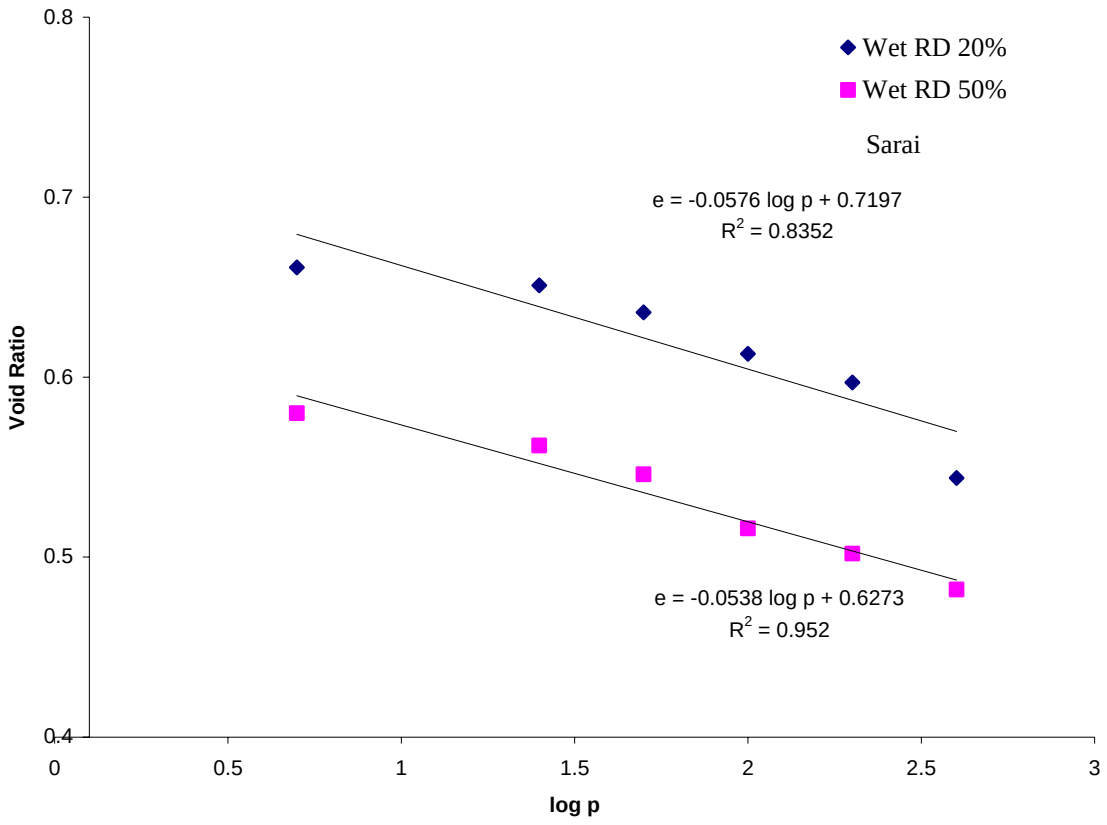

Fig. 5 Consolidation-plot for Sarai Sample

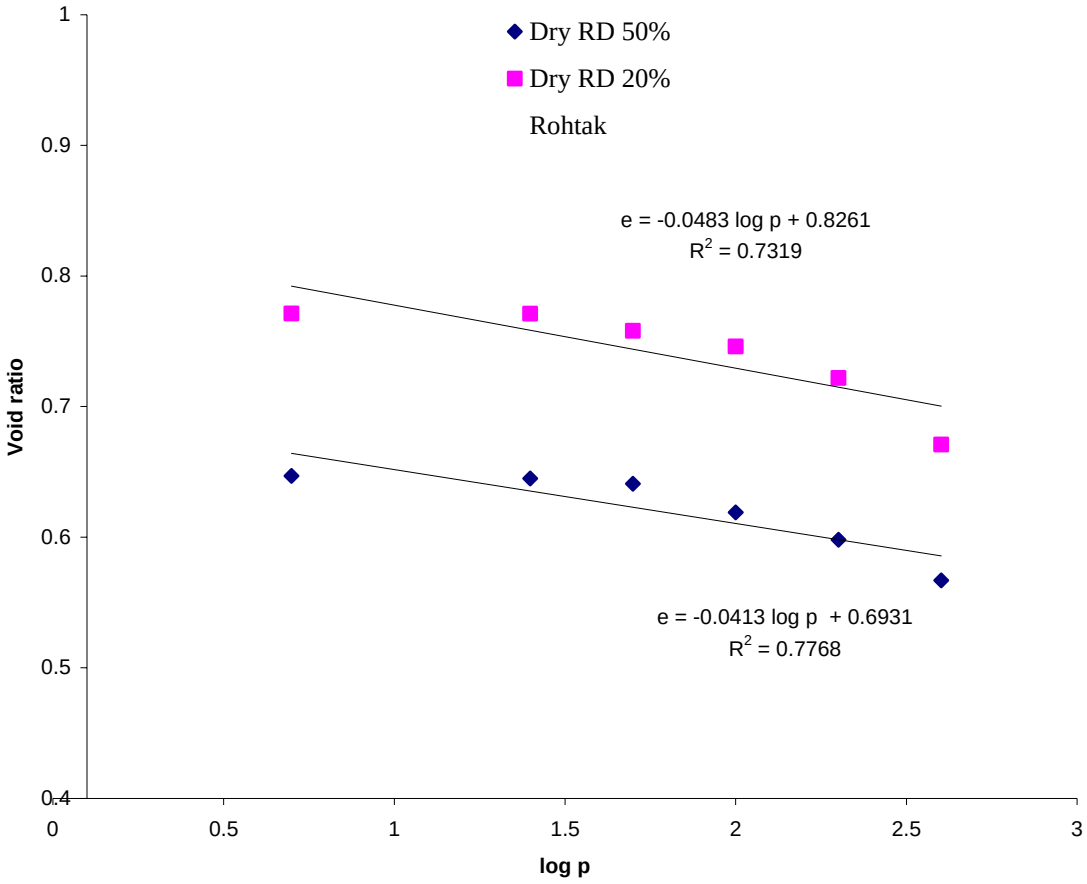

Fig. 6 Compressibility of Un-soaked Sample (Rohtak)

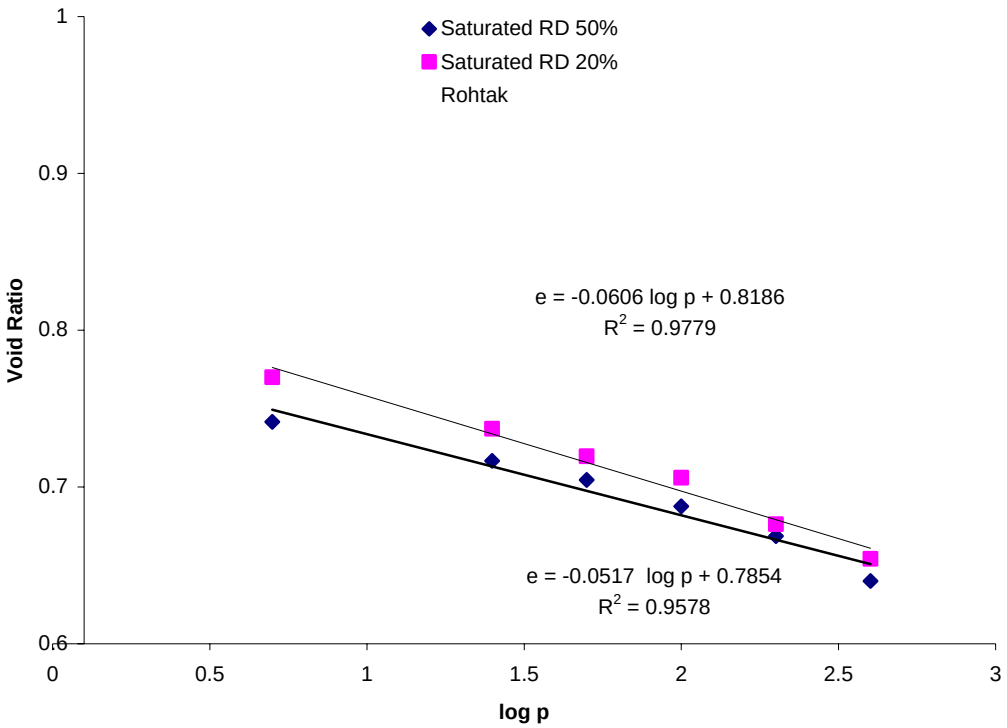

Fig. 7. Consolidation-plot for Rohtak Sample

List of Notations:

CDW Construction and demolition waste

D60 Diameter of particle at 60% finer

D30 Diameter of particle at 30% finer

D10 Diameter of particle at 10% finer

Cu Coefficient of uniformity

Cc Coefficient of curvature

C_c Compression Index

O.M.C Optimum moisture content

p Effective stress

G Specific gravity

CBR California bearing ratio

c Cohesion

ϕ Angle of internal friction

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