

## Analysis of Field Control Tests Data for Reliability at S.E.Z Project, Surat, Gujarat

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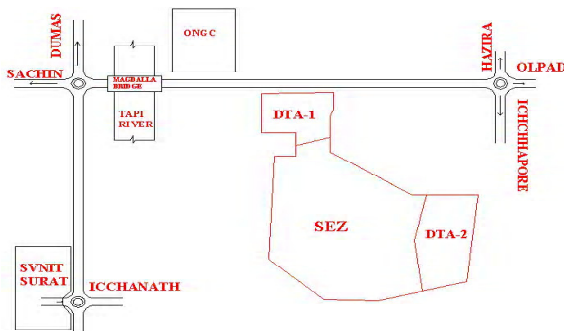
### ABSTRACT

Mass earthwork covering 50 Hectors area including interior roads for Gems & Jewellery Park developed by Gujarat Hira Bourse was technically scrutinized by Unique Eng. Testing & Advisory Services. The R & D undertaken was planned to adopt core cutter, sand replacement & nuclear density gauge to check the compaction carried out by 12 T vibratory roller. Similarly OMC was checked by Oven drying; Rapid Moisture Meter & nuclear probe. The paper present range of the grading, plasticity & swelling index, proctors modified density CBR for approved borrow area. The technique of construction is explained & control tests have been compared for the reliability. The field variation of moisture & attained density is used to plot filed compaction curve for technique of execution. The paper presents economics, time for control tests & recommends adoption of nuclear gauge both surface & up to 30 cm below for quick economical quality control test & advocate trial run to specify field OMC, MDD for procedure & plants used at site.

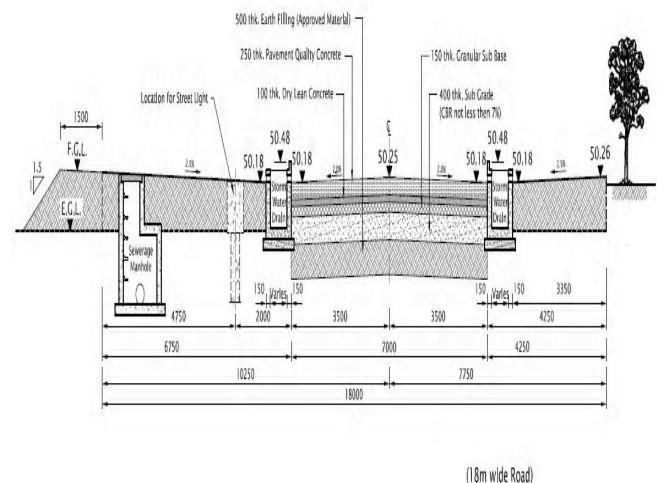
**Keywords:** Filed Testing, Monitoring, Earthwork, Quality Control test

### 1. INTRODUCTION

For approx. 50 hectors of land for Gems and Jewellery Park SEZ was selected Near Bhatpore GIDC, Ichhapore, Surat. Layout plan is given in Fig. 1. This site was flood prone. Developers Gujarat Hira Bourse planned the lay out as per fig.1. The planning of Roads and plot, to mitigate flood, require sub grade and embankment of 1.5 – 2.0 m height as shown in typical section in Fig. 2. The sub grade was cohesive moderately expansive soil.



**Fig. 1:** Layout Plan of SEZ



**Fig. 2:** Typical Road Section

### Earthwork

The site development & road fill required was about 5 lakh m<sup>3</sup> of earthwork under controlled conditions. The client assigned the quality control for the project to

**Table 1:** Borrow Area Soil

Grain Size Distribution			LL	PL	PI	FSI in %	MDD in gms/cc	OMC in %	CBR in %
Gravel	Sand	Silt + Clay							
0	69	31	22	NP	-	7	1.884	13.21	20.95
0	70	30	23	NP	-	6	1.824	16.60	13.99
0	70	30	23	NP	-	12	1.820	14.30	15.00

M/s Unique Engineering Testing Advisory Services. The job required identification of borrow areas, soil characteristics and field daily check of work at site. To optimize the work and ensure accuracy, R & D Techniques were evolved to optimize test time, construction planning and cost of quality control. The contractor adopted 12 T Vibratory roller for the earth compaction. (USBR 1986).

### Borrow Area Soil

Selected borrow pits for required supply of earth were analyzed. The Soil is predominately silty fine sand with variable small fraction of clay. It is non plastic. The range of grain size, index, CBR, OMC & MDD for number of samples is same as per Table 1 permitted only limited checks of physical properties during construction which saves time. (USBR 1986).

### Quality Control

The specification of earthwork specified range of moisture is  $OMC \pm 2\%$  and dry density 95% MDD as permissible limit. This is expected to ensure stability and CBR for trafficability of roads in industrial complex.

Properties R & D programme for data collection and analysis was performed to

- Evaluate reliability of nuclear density gauge and rapid moisture meter with respect to conventional oven dry method.
- Compare density evaluation with core cutter, sand replacement and nuclear gauge.
- Impact of different compacting plant at site (vibratory 12 T roller) on field OMC and field MDD vis a vis modified proctor density.

The seasonal temperature and draining properties of sandy soil has impact on loss of moisture at the site.

## 2. ANALYSIS OF DATA OF TESTS

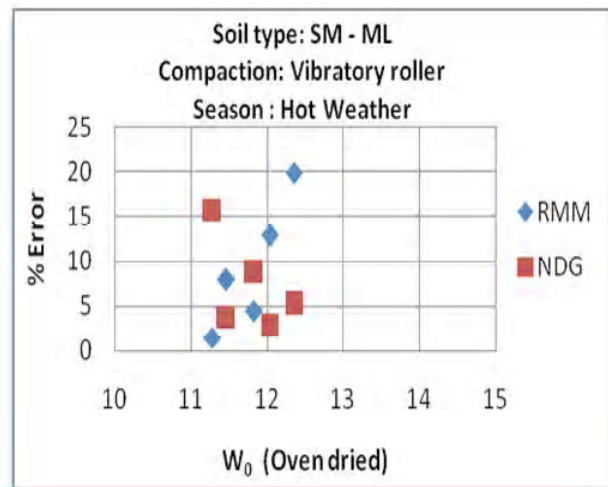
The data of number of test per layer for 20 different road locations have been analyzed. Range of OMC,

MDD in field compared to modified proctor is given in Table 2.

The field density attained by Vibratory compaction was higher by 3.4 % with corresponding field moisture less than modified proctor. The field compaction was over by 4 to 6 passes. (Holtz 1952) Average field compaction was 98 % which is higher than specified. The practice considers 24 hrs oven dried test as accurate. The comparison by 3 methods illustrated in Fig 3.

**Table 2:** Range of OMC, MDD in Field Compared to Modified Proctor

Test Method	Tested at Site		Modified Proctor	
	MDD in gms/cc	OMC in %	MDD in gms/cc	OMC in %
Nuclear Density Gauge (Matt Veenstra)	1.806	12.93	1.741	14.56
Core Cutter Method (Moisture by RMM) (IS 2720:Part29)	1.814	13.55	-	-
Sand Replacement Method (Moisture by RMM)	1.799	13.56	-	-

**Fig. 3:** Comparison of Water Content Determined by NDG & RMM w. r. to Oven Drying Method

The test embankments for soil SM-ML were compacted in hot summer with variable moisture to evaluate MDD. The compaction curves for water content by 3 techniques of measurements were developed to assess the impact of roller. The laboratory modified test OMC & MDD are 13.2 % and 1.84 g/cc respectively.

The Rapid moisture quick site test has Min. 1.5 % & Max. 19.9 % error, the range for ND gauge shows Min. 2.74 % & Max. 15.8 %. The error is negative.

Field Moisture Content V/s Dry Density relationship for energy of 12 T Vibratory is shown in Fig. 4.

The site shows moisture variations due to variable temperature from morning to evening ( $35 \pm 7^\circ\text{C}$ ) and variable humidity and wind. The field max dry density was highest by core cutter methods and same as lab test by sand replacement.

#### Time to test

Though nuclear gauge requires large capital of Rs. 5 lakhs with calibrations cost of Rs. 15000/- per year, it hardly requires 2 to 3 min. for test. Local core cutter set of Rs. 5000/- requires 15 – 20 min. Similarly sand replacement costing Rs. 10,000/- requires 15 - 20 min.

For moisture content nuclear probe & rapid moisture meter hardly requires 2 min. or less but oven drying takes 24 hrs.



Fig. 4: Photo Plate Showing Testing with NDG

### 3. CONCLUSIONS

1. Selection of borrow pits, its range of soil physical properties compaction characteristics and unsoaked CBR values reduces time to check soil composition specifications.
2. The range of variations of OMC MDD modified proctor determines range of accuracy in assessment of compaction at site. For Soil SM-ML for site.
3. For Soil SM-ML for site the use of Vibratory roller 12 T 4-6 passes at OMC – 1.0 to 2.0 % gave desired compaction for fill and hence CBR. For different roller & environment development of field compaction curve (M/c vs gd) for different Soil will provide guide lines to optimize energy of compaction.

### ACKNOWLEDGMENTS

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