



A STUDY OF SOAKING'S EFFECT ON HARYANA'S SOIL CBR VALUE

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ABSTRACT : With a particular emphasis on how soaking times impact the moisture content of the material as well as the CBR value, this study attempts to investigate how soaking affects the CBR value. Since several materials are used to make pavements, it is crucial to comprehend these materials' characteristics and interactions in order to ensure high-quality pavements. This is especially crucial for highway engineers, who not only need to comprehend the characteristics of aggregates and soil that affect the stability and endurance of the pavement, but also the binding agents that improve these qualities. Soil is a naturally occurring accumulation of earth material that is produced by the disintegration of rocks or vegetation. It is an essential component. In a lab, it breaks down softly or is easily dug up. The earth beneath the pavement and its specific underlying layers are referred to as "subgrade"; the undisturbed soil is known as the natural subgrade, while the compacted subgrade is the soil that has been forced into tight spaces by large compactors. The strength and stiffness of the subgrade greatly affect the pavement's performance. Among various methods for evaluating subgrade strength, the CBR test is significant. A quick estimation of the CBR value is vital for highway engineers. Therefore, this study focuses on comparing the soaked and unsoaked CBR values. Higher soaking levels are found to cause a decrease in the CBR value and an increase in moisture content.

1. INTRODUCTION

1.1 THE NECESSITY OF RESEARCH

Flood-caused In Haryana, road damage is a common occurrence that requires large sums of money for road reconstruction following each flooding incident. Thus, it is now crucial to conduct research aimed at pinpointing the

precise mechanisms by which floods harm roads. There is a need for experimental verification as there are several potential contributing variables to these impairments. This study aims to ascertain the effects of submergence depth and duration on the subgrade strength of soil samples taken from the Panipat-Israna National Highway. These samples underwent California Bearing Ratio (CBR) testing at various submersion depths following both short and extended soaking periods. Furthermore, index and identification tests were carried out to classify the soils and ascertain whether they could be used as subgrade material. However, it was found that all three of the investigated soil types were classified as poor subgrade materials by the IS soil categorization system. Pavement layer structure is significantly impacted by the strength of the subgrade soil beneath it. A common way to describe the strength of a subgrade is to utilize its CBR value. On weaker subgrades, thicker pavement layers are typically vital, whereas on stronger subgrades, thinner layers may be supported. Both the pavement and the subgrade together must be able to support the traffic load. The Indian Road Congress (IRC) provides specific design guidelines for pavement layers based on the subgrade strength, which is primarily determined by the CBR value of a field or laboratory sample that has been submerged in water for four days. The water table's fluctuations, capillary action, and rainfall are only a few of the factors that constantly alter the moisture content of the subgrade. Engineers must understand how variations in moisture content affect the subgrade's strength. This project aims to investigate the relationship between changes in moisture content and the effects of soaking on the CBR value at different soaking times. Increased soaking times are associated with higher moisture content and lower CBR values, according to the data.

1.2 PURPOSES AND ANALYZATION AREAS

The California Bearing Ratio (CBR) test is commonly used in Haryana to measure the subgrade strength in order to design roadway pavement. Direct use of either laboratory or field CBR testing is possible for this evaluation. However, establishing a clear correlation between the results of laboratory CBR trials conducted without immersion and the soaked CBR values is often challenging. Finding the local correlation between these two measurements—the CBR values from the soaking and the non-soaking laboratory testing—is the aim of this thesis. This connection will compare the CBR values from wet and unsoaked tests in particular, with respect to soil samples that have the same ratios of sand to clay. Flexible pavement designs in Haryana often take into account the subgrade's CBR value. This kind of testing is expensive and time-consuming, thus only a small number of experiments are usually carried out. It is difficult to precisely ascertain differences in CBR values along road lengths because of this constraint. Subgrade strength along road segments would be much improved if a technique to determine CBR values utilizing speedier, less expensive, and simpler tests could be created. This is particularly important in certain Indian states where there is a pressing need for the quick construction of rural connections on low-volume roads. Previous studies in this field have produced techniques for calculating CBR values based on the outcomes of simple, quick, and inexpensive experiments. The purpose of this thesis is to validate the estimated CBR values obtained using these techniques in accordance with IRC: SP: 72-2007 criteria.

The following are the precise goals of this research:

1. To gather a particular sample of soil and ascertain its basic physical characteristics including the distribution of grain size and the Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI).
2. To analyse the soil using modified proctor compaction, determining the Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) for the soil sample.
3. To conduct CBR tests on the sample after soaking it for different durations
4. To investigate how long soaking affects the subgrade's strength.

The following are the typical values for Californian crushed rock:

Table No. 1
(Standard breaks up valuable Californian rock)

LOAD (kN)	13.24	19.96
PENETRATION (mm)	2.5	5.0

2. VALIDATION OF SOIL SUBGRADE'S CBR

2.1 EQUIPMENT:

- a) Loading machine: Any compression mechanism that can run at a constant 1.25 mm per minute will do.
- b) Cylindrical molds: These molds are 175 mm tall and 150 mm in diameter. They are equipped with a collar that is approximately 50 mm long and a detachable, perforated base.
- c) Compaction hammer.
- d) Surcharge weights: Annular weights, each weighing 2.5kg and with a diameter of 147mm.
- e) 19 mm IS sieve, coarse filter paper, measuring scale, and further relevant components.

2.2 PROCEDURE

The test can be performed on both undisturbed and remolded samples. The loads at the 2.5mm and 5mm penetrations are recorded when a cylindrical plunger with a 50mm diameter is pushed into the material at a constant 1.25mm/minute pace. Next, by expressing these loads as a percentage of the standard load value at comparable deformation levels, the CBR value is found.

To start the process, the material is first passed through a 19 mm IS sieve. About 5 kg of soil sample is taken, and water is added to determine the field moisture content, also known as the optimum moisture content. The soil and water are then thoroughly mixed. A spacer disc is placed on top of the base plate at the bottom of the mold, and then a layer of coarse filter paper is placed on top of it. The prepared soil-water combination is divided into five equal parts. One fifth of the soil mixture is poured into the mold after it has been cleaned and lightly oiled. A 4.89 kg hammer is used to compress this layer in 56 equal strokes. The surface of the previous compacted layer is scraped before the next one is applied. After the third layer, a collar attached to the mold is used to continue the filling and compacting process. After removing the collar, any remaining dirt is smoothed off.

It applies the fifth layer. The mold is inverted and clamped back to the plate after the base plate has been removed.

Surcharge weights weighing 2.5 kg are placed on top of the soil. The mold that holds the specimen is assembled on the testing instrument. The plunger is positioned to make contact with the soil, and a sitting load of 4 kg is provided to make sure that the soil and the penetration plunger establish proper contact. A load is supplied to achieve a 1.25 mm rate of penetration after zeroing the dial readings. Records exist for the penetrations of 0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 7.5, 10, and 12.5 mm in terms of loads.

When designing new roads in Haryana, the CBR value—which can be calculated in a number of ways—is used to evaluate the subgrade's strength.

- With reference to the table in IRC:SP:72-2007, which provides average presumptive design CBR values based on soil classification testing, for soil samples compacted to Proctor density and soaked in water for four days at ideal moisture content.
- Using a monograph and data from wet sieve examination, estimate the 4-day soaked CBR values for samples compacted to Proctor density.
- Applying two sets of equations—one for plastic soils and another for non-plastic topsoil—derived from classification test data is necessary to estimate soaking CBR values for samples compacted to Proctor density.
- Conducting real-world CBR experiments in the lab.
- Methods three and four are particularly useful in situations where comprehensive testing facilities are not available, or the scale of the project does not justify extensive testing procedures.

2.3 EASY CBR ESTIMATION

For plastic soil:

The formula is used to determine the CBR value.

$CBR = 75 / (1 + 0.728 \text{ WPI})$, where

WPI represents the weighted plasticity index, calculated as $P_{0.075} \times PI$. Here, PI is the Plasticity Index of the soil expressed as a percentage, and $P_{0.075}$ is the percentage of soil passing through a 0.075 mm sieve, expressed in decimal form.

For non-plastic soil:

The formula is used to determine the CBR value.

$CBR = 28.091(D_{60})^{0.3581}$, where

D_{60} refers to the diameter in millimetres of the soil particle size that corresponds to 60% finer in the grain size distribution.

These soil classification methods are useful for preparing preliminary reports in Haryana.

2.4 I R C SUGGESTIONS FOR THE CBR DESIGN METHOD

The following are the main suggestions made by the IRC for Haryana's CBR approach of design (IRC:37-1970):

- In the lab, remolded soils should be utilized for CBR testing. Using in-situ tests for design reasons is not recommended. If static compaction is not possible, then dynamic compaction should be used to prepare

the specimens in compliance with the standard test methodology.

- Subgrade samples of soil for new roadways should be compacted at Optimum Moisture Content (OMC) to Proctor density if suitable compaction equipment is available to accomplish this density in the field; if not, the soil sample may be compacted to a dry density that can be obtained in the field. For roads currently in use, the sample must be compacted to the field density of the subgrade soil (either at field moisture content or at OMC).
- Before testing, CBR specimens for buildings that were recently built should be submerged beneath water for four days. In contrast to arid regions, when annual rainfall is less than 50 cm, the water table does not significantly affect the subgrade, and thick, impervious bituminous surfacing is present, it might not be necessary to soak the soil specimen prior to the CBR test. Whenever possible, field study should be done to identify the most unfavourable moisture status of the subgrade.
- Three identical specimens of identical porosity and level of moisture should be tested for each type of soil. If the greatest disparity in CBR values between the three specimens is more than the predefined limits, the design CBR should be the average of at least six samples. The indicated limits of maximum change in CBR are three for values up to ten, five for values between ten and thirty, and ten for readings between thirty and sixty percent.
- At least 95–100% of the Proctor density should be achieved in the top 50 cm of the subgrade.
- An estimation of the traffic that will be carried by the road pavement at the end of its expected life should be developed, factoring for both existing traffic and future growth arising from changes in land use. Designing for major road pavements must consider a minimum 10-year lifespan. The formula $A = P(1+r)^{(n+10)}$ can be used to predict traffic patterns. Here, P represents the average per day count of heavy vehicles at the last count, r means the annual rate of increase in heavy vehicles, n is the number of years between the last count and the year that construction gets done, and A is the everyday count of heavy vehicles for design.
- For design purposes, traffic involving heavy vehicles (laden weight exceeding three tons) in both directions is taken into account. This traffic is classified into seven categories, which range from A to G. The appropriate design curve should be chosen using the table in the design chart. The design thickness is used for randomized axle loads up to 14,500 kg and single axle pressures up to 8,200 kg.

Higher axle loads require thickest values to be upgraded.

- The CBR value of these materials may not be important in the design of layers that follows in situations when significant amounts of the aggregates in sub-base course components are larger than 20 mm. Because they don't structurally support the pavement, wearing course layers, such as toppings or open-graded premixed carpet up to 2.5 cm thick, shouldn't be taken as consideration when calculating the entirety of the thickness of the pavement.

3 EXAMINATIONS & OUTCOMES

3.1 EXAMINATION & OUTCOMES OF SAMPLE 1

(Examination & Outcomes of sample No. 1)

Atterberg's Limit										
Liquid Limit (LL)%	Plastic Limit (PL)%	Plasticity Index (PI) %	Free Swell Index	Mass Dry Density gm/cc	OMC%	CBR Unsoaked (0 Hrs.)	CBR soaked (24 Hrs.)	CBR soaked (48 Hrs.)	CBR soaked (72 Hrs.)	CBR with 4 day Soaking
38.40	20.53	17.87	24.5	1.9	12	18.57	9.66	7.14	6.05	5.02

The Sample No. 1 Observation Reports are provided below:

- Grain Size Analysis
- Consistency Limit
- Free Swell Index
- MDD & OMC
- CBR Unsoaked
- CBR Soaked

GRAIN SIZE ANALYSIS OF SAMPLE NO.1
SOIL GRAIN SIZE ANALYSIS (AS PER IS 2720 PART (4) 1985RA:2006)

LOCATION :- NAULTHA
WEIGHT OF SOIL SAMPLE = 3000gm

A. DRY SIEVING

S NO	I.S SIEVE DESIGNATION	WT. OF SAMPLE RETAINED (gm)	% of WT. RETAINED	CUMULATIVE % OF WT. RETAINED	% PASSING
1	80 mm				
2	63 mm				
3	40 mm				
4	25 mm				
5	12.5 mm	0	0	0	100
6	10 mm	0	0	0	100
7	4.75 mm	0	0	0	100
8	PAN				

A. DRY SIEVING

S NO	I.S SIEVE DESIGNATION	WT. OF SAMPLE RETAINED (gm)	% of WT. RETAINED	CUMULATIVE % OF WT. RETAINED	% PASSING
1	2.36 mm	214	7.13	7.1	92.9
2	1.18 mm	346	11.53	18.7	81.3
3	600 micron	704	23.47	42.1	57.9
4	425 micron	308	10.27	52.4	47.6
5	75 micron	186	6.2	58.6	41.4

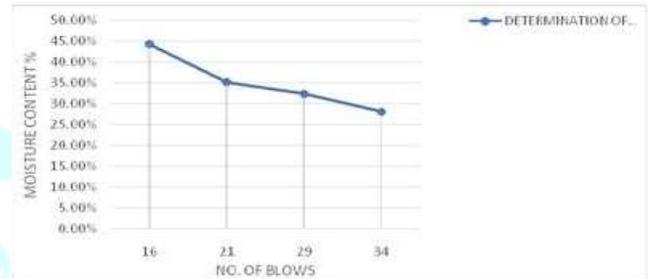
CLAY/SILT (-75 micron) 41.40%
SAND (-4.75 mm, +75 micron) 58.60%
GRAVEL (-40mm, +4.75mm) 0.00%

TEST OBSERVATION SHEET LIQUID LIMIT & PLASTIC LIMIT TEST (AS PER IS 2720 Part (V) 1985 RA:2001)

SAMPLE BY MAYANK KUMAR
TYPE OF MATERIAL SOIL

S. No	No. of blows	Tin no.	Wt. of Tin (gm)	Wt. of Tin + wet soil (gm)	Wt. of Tin + Dry soil (gm)	Loss of Water (gm)	Wt. of dry Soil (gm)	Moisture Content %
1	16	4	14.61	39.29	30.93	7.23	16.32	44.30%
2	21	6	15.96	43.27	34.26	6.45	18.3	35.25%
3	29	7	17.52	41.84	34.67	5.56	17.15	32.42%
4	34	10	16.35	36.56	30.97	4.12	14.62	28.18%

Liquid Limit (L.L.)=34.50%



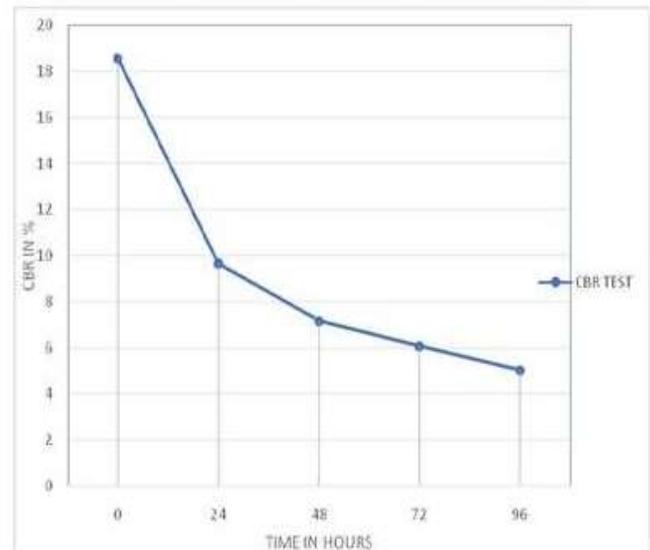
DETERMINATION OF PLASTIC LIMIT

Sl. No	Tin No	Wt. of Tin (gm)	Wt. of Tin+Wet soil (gm)	Wt. of Tin + Dry Soil (gm)	Loss of Water (gm)	Wt. of Dry Soil (gm)	Moisture Content %
1	14	16.57	22.44	21.45	0.99	4.88	20.29%
2	15	14	21.95	20.58	1.37	6.58	20.82%
3	16	14.61	20.43	19.44	0.99	4.83	20.50%

PLASTIC LIMIT (P.L.) 20.53%
PLASTICITY INDEX (PI) 13.97% (LL-PL)

VARIATION OF CBR WITH TIME OF SOAKING SAMPLE NO. 1

CBR UNSOAKED (0Hrs.)	CBR UNSOAKED (24Hrs.)	CBR UNSOAKED (48Hrs.)	CBR UNSOAKED (72Hrs.)	CBR UNSOAKED (96Hrs.)
18.57	9.66	7.14	6.05	5.02



3.2 EXAMINATION & OUTCOMES OF SAMPLE 2

(Examination & Outcomes of sample No. 2)

Atterberg's Limit			Free Swell Index	Mass Dry Density gm/cc	OMC%	CBR Unsoaked (0 Hrs.)	CBR soaked (24 Hrs.)	CBR soaked (48 Hrs.)	CBR soaked (72Hrs.)	CBR with 4 day Soaking
Liquid Limit (LL)%	Plastic Limit (PL)%	Plasticity Index (PI) %								
34.50	20.53	13.97	29.25	1.9	12	25.25	13.37	10.40	7.35	6.19

The Sample No. 2 Observation Reports are provided below:

1. Grain Size Analysis
2. Consistency Limit
3. Free Swell Index
4. MDD & OMC
5. CBR Unsoaked
6. CBR Soaked

GRAIN SIZE ANALYSIS OF SAMPLE NO.2

SOIL GRAIN SIZE ANALYSIS (AS PER IS 2720 PART (4) 1985 RA:2006)

LOCATION :- GOHANA

WEIGHT OF SOIL SAMPLE = 3000 gm

A. DRY SIEVING

S NO	I.S SIEVE DESIGNATION	WT. OF SAMPLE RETAINED (gm)	% of WT. RETAINED	CUMULATIVE %OF WT. RETAINED	% PASSING
1	80 mm				
2	63 mm				
3	40 mm				
4	25 mm				
5	12.5 mm	0	0	0	100
6	10 mm	0	0	0	100
7	4.75 mm	0	0	0	100
8	PAN				

A. DRY SIEVING

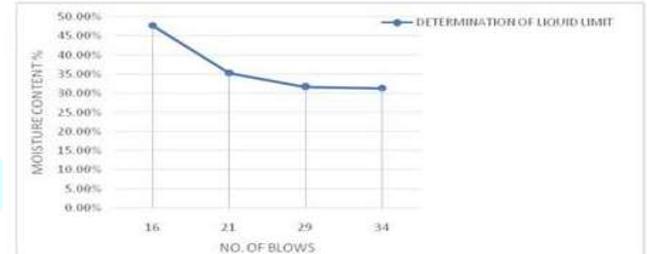
S NO	I.S SIEVE DESIGNATION	WT. OF SAMPLE RETAINED (gm)	% of WT. RETAINED	CUMULATIVE %OF WT. RETAINED	% PASSING
1	2.36 mm	201	6.7	6.7	93.3
2	1.18 mm	357	11.9	18.6	81.4
3	600 micron	724	24.13	42.7	57.3
4	425 micron	294	9.8	52.5	47.5
5	75 micron	170	5.67	58.2	41.8

CLAY/SILT (-75 micron) 41.80%
 SAND (-4.75 mm, +75 micron) 58.20%
 GRAVEL (-40mm, +4.75mm) 0.00%

TEST OBSERVATION SHEET
 LIQUID LIMIT & PLASTIC LIMIT TEST (AS PER IS 2720 Part (V) 1985 RA:2001)
 SAMPLE BY MAYANK KUMAR
 TYPE OF MATERIAL SOIL

S.no	No. of blows	Tin no.	Wt. of Tin	Wt. of Tin +wet soil	Wt. of Tin +Dry soil	Loss of Water	Wt. of dry Soil	Moisture Content
			(gm)	(gm)	(gm)	(gm)	(gm)	%
1	16	4	14.61	39.29	30.93	7.77	16.32	47.61%
2	21	6	15.96	43.27	34.26	6.46	18.3	35.30%
3	29	7	17.52	41.84	34.67	5.44	17.15	31.72%
4	34	10	16.35	36.56	30.97	4.58	14.62	31.33%

Liquid Limit (L.L.)=33.26%



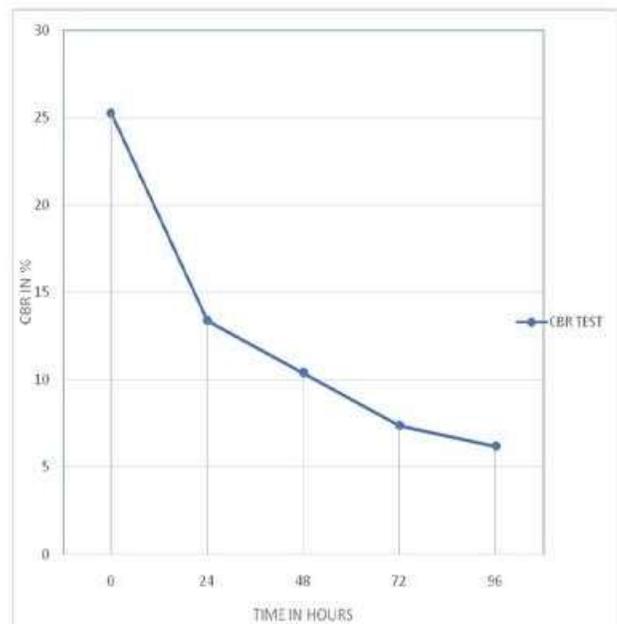
DETERMINATION OF PLASTIC LIMIT

Sl. No	Tin No	Wt. of Tin	Wt. of Tin+Wet soil	Wt. of Tin + Dry Soil	Loss of Water	Wt. of Dry Soil	Moisture Content
		(gm)	(gm)	(gm)	(gm)	(gm)	%
1	14	16.57	22.44	21.45	0.99	4.88	20.29%
2	15	14	21.95	20.58	1.37	6.58	20.82%
3	16	14.61	20.43	19.44	0.99	4.83	20.50%

PLASTIC LIMIT (P.L) 20.5:
 PLASTICITY INDEX (PI) 12.7: (LL-PL)

VARIATION OF CBR WITH TIME OF SOAKING
 SAMPLE NO. 2

CBR UNSOAKED (0Hrs.)	CBR UNSOAKED (24Hrs.)	CBR UNSOAKED (48Hrs.)	CBR UNSOAKED (72Hrs.)	CBR UNSOAKED (96Hrs.)
25.25	13.37	10.4	7.35	6.19



3.3 EXAMINATION & OUTCOMES OF SAMPLE 3

(Examination & Outcomes of sample No. 3)

Atterberg's Limit			Free Swell Index	Mass Dry Density gm/cc	OMC %	CBR Unsoaked (0 Hrs.)	CBR soaked (24 Hrs.)	CBR soaked (48 Hrs.)	CBR soaked (72Hrs.)	CBR with 4 day Soaking
Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI) %								
33.26	20.53	12.73	16.3	1.87	9	21.54	12.63	11.88	10.40	8.37

The Sample No. 3 Observation Reports are provided below:

1. Grain Size Analysis
2. Consistency Limit
3. Free Swell Index
4. MDD & OMC
5. CBR Unsoaked
6. CBR Soaked

GRAIN SIZE ANALYSIS OF SAMPLE NO.3

SOIL GRAIN SIZE ANALYSIS (AS PER IS 2720 PART (4) 1985 RA:2006)

LOCATION :- MODEL TOWN SECTOR 28

WEIGHT OF SOIL SAMPLE = 3000 gm

A. DRY SIEVING

S NO	I.S SIEVE DESIGNATION	WT. OF SAMPLE RETAINED (gm)	% of WT. RETAINED	CUMULATIVE %OF WT. RETAINED	% PASSING
1	80 mm				
2	63 mm				
3	40 mm				
4	25 mm				
5	12.5 mm	0	0	0	100
6	10 mm	0	0	0	100
7	4.75 mm	0	0	0	100
8	PAN				

A. DRY SIEVING

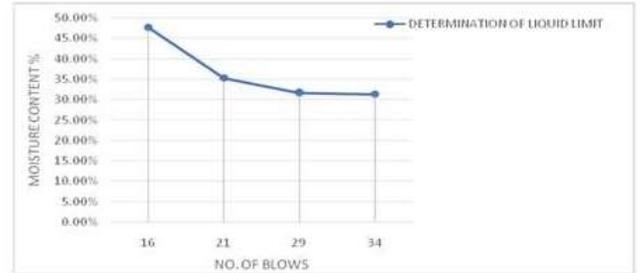
S NO	I.S SIEVE DESIGNATION	WT. OF SAMPLE RETAINED (gm)	% of WT. RETAINED	CUMULATIVE %OF WT. RETAINED	% PASSING
1	2.36 mm	225	7.5	7.5	92.5
2	1.18 mm	268	8.93	16.4	83.6
3	600 micron	748	24.93	41.4	58.6
4	425 micron	294	9.8	51.2	48.8
5	75 micron	145	4.83	56	44

CLAY/SILT (-75 micron) 44.00%
 SAND (-4.75 mm, +75 micron) 56.00%
 GRAVEL (-40mm, +4.75mm) 0.00%

TEST OBSERVATION SHEET
 LIQUID LIMIT & PLASTIC LIMIT TEST (AS PER IS 2720 Part (V) 1985 RA:2001)
 SAMPLE BY MAYANK KUMAR
 TYPE OF MATERIAL SOIL

S.no	No. of blows	Tin no.	Wt. of Tin (gm)	Wt. of Tin +wet soil (gm)	Wt. of Tin +Dry soil (gm)	Loss of Water (gm)	Wt. of dry Soil (gm)	Moisture Content %
1	16	4	14.61	39.29	30.93	7.77	16.32	47.61%
2	21	6	15.96	43.27	34.26	6.46	18.3	35.30%
3	29	7	17.52	41.84	34.67	5.44	17.15	31.72%
4	34	10	16.35	36.56	30.97	4.58	14.62	31.33%

Liquid Limit (L.L.)=33.26%



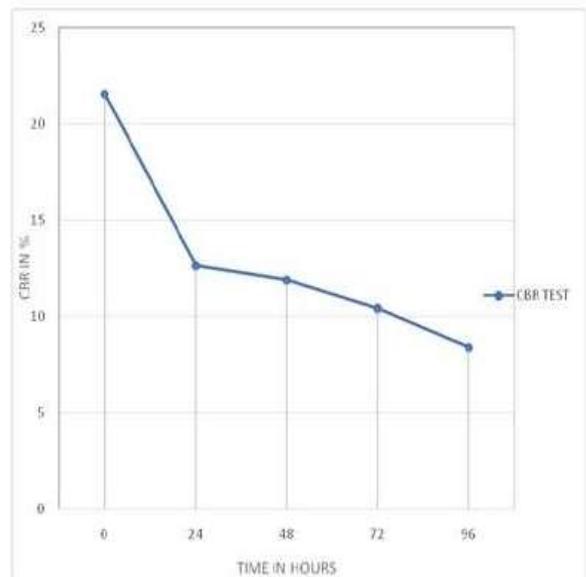
DETERMINATION OF PLASTIC LIMIT

Sl. No	Tin No	Wt. of Tin (gm)	Wt. of Tin+Wet soil (gm)	Wt. of Tin + Dry Soil (gm)	Loss of Water (gm)	Wt. of Dry Soil (gm)	Moisture Content %
1	14	16.57	22.44	21.45	0.99	4.88	20.29%
2	15	14	21.95	20.58	1.37	6.58	20.82%
3	16	14.61	20.43	19.44	0.99	4.83	20.50%

PLASTIC LIMIT (P.L) 20.5:
 PLASTICITY INDEX (PI) 12.7: (LL-PL)

VARIATION OF CBR WITH TIME OF SOAKING SAMPLE NO. 3

CBR UNSOAKED (0Hrs.)	CBR UNSOAKED (24Hrs.)	CBR UNSOAKED (48Hrs.)	CBR UNSOAKED (72Hrs.)	CBR UNSOAKED (96Hrs.)
21.54	12.63	11.88	10.4	8.37



3.4 EXAMINATION & OUTCOMES OF SAMPLE 4

(Examination & Outcomes of sample No. 4)

Atterberg's Limit			Free Swell Index	Mass Dry Density gm/cc	OMC %	CBR Unsoaked (0 Hrs.)	CBR soaked (24 Hrs.)	CBR soaked (48 Hrs.)	CBR soaked (72Hrs.)	CBR with 4 day Soaking
Liquid Limit (LL) %	Plastic Limit (PL) %	Plasticity Index (PI) %								
31.53	20.53	11.00	19.30	1.93	10	17.83	9.66	8.91	7.43	5.31

The Sample No. 4 Observation Reports are provided below:

1. Grain Size Analysis
2. Consistency Limit
3. Free Swell Index
4. MDD & OMC
5. CBR Unsoaked
6. CBR Soaked

GRAIN SIZE ANALYSIS OF SAMPLE NO.4

SOIL GRAIN SIZE ANALYSIS (AS PER IS 2720 PART (4) 1985 RA:2006)

LOCATION :- ISRANA

WEIGHT OF SOIL SAMPLE = 3000 gm

A. DRY SIEVING

S NO	I.S SIEVE DESIGNATION	WT. OF SAMPLE RETAINED (gm)	% of WT. RETAINED	CUMULATIVE %OF WT. RETAINED	% PASSING
1	80 mm				
2	63 mm				
3	40 mm				
4	25 mm				
5	12.5 mm	0	0	0	100
6	10 mm	0	0	0	100
7	4.75 mm	0	0	0	100
8	PAN				

A. DRY SIEVING

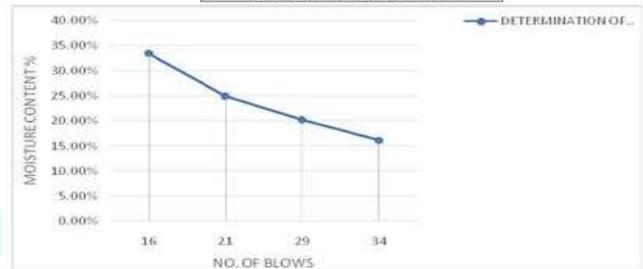
S NO	I.S SIEVE DESIGNATION	WT. OF SAMPLE RETAINED (gm)	% of WT. RETAINED	CUMULATIVE %OF WT. RETAINED	% PASSING
1	2.36 mm	267	8.9	8.9	91.1
2	1.18 mm	364	12.13	21	79
3	600 micron	167	5.57	26.6	73.4
4	425 micron	298	9.93	36.5	63.5
5	75 micron	168	5.6	42.1	57.9

CLAY/SILT (-75 micron) 57.90%
 SAND (-4.75 mm, +75 micron) 42.10%
 GRAVEL (-40mm, +4.75mm) 0.00%

TEST OBSERVATION SHEET
 LIQUID LIMIT & PLASTIC LIMIT TEST (AS PER IS 2720 Part (V) 1985 RA:2001)
 SAMPLE BY MAYANK KUMAR
 TYPE OF MATERIAL SOIL

S.no	No. of blows	Tin no.	Wt. of Tin (gm)	Wt. of Tin + wet soil (gm)	Wt. of Tin + Dry soil (gm)	Loss of Water (gm)	Wt. of dry Soil (gm)	Moisture Content %
1	16	4	14.61	39.29	30.93	5.46	16.32	33.46%
2	21	6	15.96	43.27	34.26	4.56	18.3	24.92%
3	29	7	17.52	41.84	34.67	3.47	17.15	20.23%
4	34	10	16.35	36.56	30.97	2.36	14.62	16.14%

Liquid Limit (L.L.)=31.53%



DETERMINATION OF PLASTIC LIMIT

Sl. No	Tin No	Wt. of Tin (gm)	Wt. of Tin + Wet soil (gm)	Wt. of Tin + Dry Soil (gm)	Loss of Water (gm)	Wt. of Dry Soil (gm)	Moisture Content %
1	14	16.57	22.44	21.45	0.99	4.88	20.29%
2	15	14	21.95	20.58	1.37	6.58	20.82%
3	16	14.61	20.43	19.44	0.99	4.83	20.50%

PLASTIC LIMIT (P.L.) 20.53%
 PLASTICITY INDEX (PI) 11.00% (LL-PL)

VARIATION OF CBR WITH TIME OF SOAKING SAMPLE NO. 4

CBR UNSOAKED (0Hrs.)	CBR UNSOAKED (24Hrs.)	CBR UNSOAKED (48Hrs.)	CBR UNSOAKED (72Hrs.)	CBR UNSOAKED (96Hrs.)
17.83	9.66	8.91	7.43	5.31

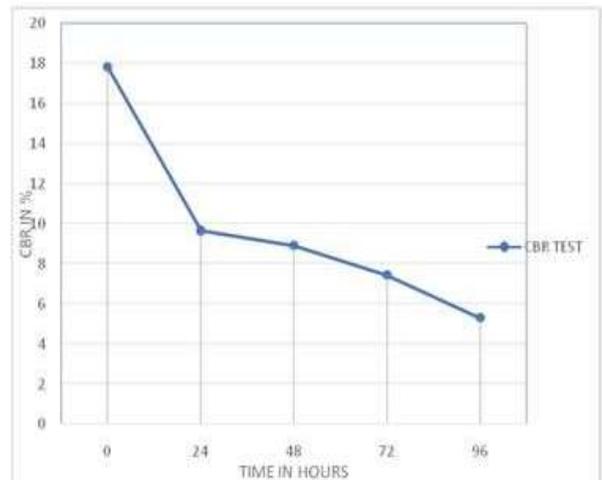
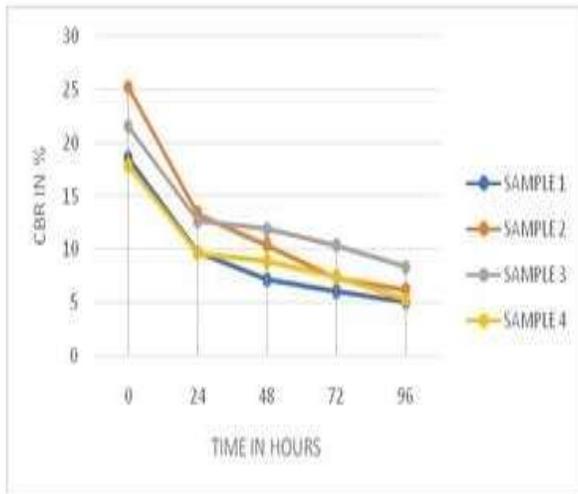


FIG NO 29
 CBR VARIATION WITH TIME

(Variation of CBR with time of soaking of sample no.1 to 4)

Sample No.	CBR	CBR	CBR	CBR	CBR
	RESULT (0 Hrs.)	RESULT (24 Hrs.)	RESULT (48 Hrs.)	RESULT (72 Hrs.)	RESULT (96 Hrs.)
1	18.57	9.66	7.14	6.05	5.02
2	25.25	13.37	10.4	7.35	6.19
3	21.54	12.63	11.88	10.4	8.37
4	17.83	9.66	8.91	7.43	5.31



4. REFERENCES

- Arora K.R. "A Text book of Soil Mechanics"
- Bindra S.P. "A Text Book of Highway Engineering" Dhanpat Rai Publications, New Delhi.
- Khanna S.K. and C.E.G. Justo, Nem Chand & Bros; Roorkee Highway engineering.
- Mathew V. Tom, (2009), Entitled "Pavement materials: Soil Lecture notes in Transportation Systems Engineering.
- Punmia B.C., Ashok Kumar Jain & Arun Kumar Jain "A Text Book of Soil Mechanics & Foundations".
- Sahoo Biswajeet & Nayak Devadatta, (2009) "A Study of Subgrade Strength Related to moisture".
- Singhal, R.P. (1967). Soil Mechanics and Foundation Engineering, Singhal Publications, India.
- Terzaghi, K. (1943). Theoretical soil Mechanics, Chapman and Hall, London and John Wiley & Sons.
- IS 2720 Part-5 "Method of test for Soil-Determination of Liquid limit and Plastic limit".
- IS 2720 Part-8 "Method of test for Soil-Determination of Water Content, Dry density relation using a heavy Compaction".
- IS 2720 Part-16 "Methods of test for Soil-Laboratory determination of CBR" Partha Chakroborty & Animesh Das "Principles of Transportation Engineering" Ministry of Road Transport and Highways Report of the Specifications for Road and Bridge Work in India.
- IRC-SP 72-2007, "Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads" IRC, New Delhi.
- Indian Roads Congress, Guidelines for the design of flexible pavements (second revision), IRC: 37-2001.
- Road Research Laboratory, Soil mechanics for road engineers, DSIR, HMSO publication, India.