International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 06 | June 2022 www.irjet.net p-ISSN: 2395-0072

DESIGN OF BLANKETING MATERIAL

Eldhose M Manjummekudiyil[2], Anjitha Rajan[1], Liniya Merin Mathew[1], Mariya Thankachan[1], Remitha P J[1]

[1]Student, Dept. of Civil Engineering, Mar Athanasius College of Engineering, Kerala, India
[2]Professor, Dept. of Civil Engineering, Mar Athanasius College of Engineering, Kerala, India

---***---

Abstract - *Increased traffic and speed have increased the structural demand on conventional tracks. Earlier while improving the track system, the blanketing layer was not considered as important. Later it is found that the design of a blanketing layer on top of the formation is a necessity for the stability of tracks, proper drainage, and strength. The blanket layer is the layer between the ballast and subgrade that spread over the entire width. It is of specified coarse and granular materials of designed thickness. The absence or improper design of a blanket layer causes speed restriction, high maintenance costs, and difficulty in maintenance.*

This study is an attempt to develop an economic and optimum proportion of coarse and granular material to reach a good quality blanket layer. The investigations are all to meet the specifications as recommended by RDSO. The mix proportion is based on gradation analysis, standard proctor compaction test, and CBR test.

Key Words: Blanketing material, Soil, Aggregate, CBR value

1. INTRODUCTION

Over the years, increases in traffic and speeds have placed a greater structural demand on conventional tracks, constructed initially to cater for lighter traffic. Gradual improvement of track system has been to track superstructure. Track sub-structure below ballast has received less attention. It has also become important to make sure the quality of tracks for safe, comfortable, and cost-effective passage of trains in designed situations.

The provision of a blanket layer on top of formation has become a necessity because its absence may lead to speed restrictions, and costly maintenance practices as well have become an obstacle to the introduction of higher speed and higher axle load. The blanket layer is the layer between the ballast and subgrade that spread over the entire width. It is of specified coarse and granular materials of designed thickness. The blanket layer helps in spreading the load on formation, limiting subgrade stresses within the subgrade strength thereby ensuring the long-term safe utility of the tracks.

RDSO has issued GE: G-0014 guidelines regarding the material to be used in the Blanket layer.

Traditionally, a blanket layer of single specified material was recommended, which becomes very costly and difficult to provide. Under the circumstances, a two-layer blanket system has been studied for use in the top portion of formation from strength as well as economic considerations. In this project, we are mixing soil and aggregate samples according to different proportions on a trial-and-error basis and arriving at an optimum proportion given strength and economy.

1.1. Aim

To design an appropriate mix proportion of blanketing material below railway track as per RDSO guidelines and IS specifications.

1.2. Scope

In the scenario of large-scale development of Railway through laying of new track, conversion of existing single tracks to double or more ones, modernizing of old tracks to accommodate high-speed trains, blanketing layer design has gained a wide acceptance due to its importance in tracks for safe and comfortable and cost-effective passage of the train.

2. METHODOLOGY

To achieve the objectives of our work, soil and aggregate samples which were available in nearby location was collected. The properties of materials were tested individually and together by choosing three different mix proportions on a trial-and-error basis. The various process involved in the execution of the works is given in the flow chart below.

COLLECTION OF SOIL SAMPLE

↓

SIEVE ANALYSIS OF SOIL

↓

ATTERBERG'S LIMIT TEST

↓

STANDARD PROCTOR COMPACTION TEST

↓

CBR TEST

↓

COLLECTION OF AGGREGATE SAMPLE

↓

SIEVE ANALYSIS OF AGGREGATE

↓

LOS ANGELES ABRASION VALUE TEST ON AGGREGATE

↓

SIEVE ANALYSIS OF DESIGN MIXES

↓

HEAVY PROCTOR COMPACTION TEST ON MIXES

↓

SOAKED CBR TEST ON MIXES

3. MATERIALS TESTED AND RESULTS

3.1. Soil sample

Figure 1 soil sample

3.1.1. Gradation analysis

The grain size analysis of the soil sample was conducted according to IS 2720 Part IV of BIS. The observation with the result is shown in Table1.

Table1 Observation Of Gradation Analysis Of Soil Sample

Particle size (mm)	Percentage weight retained (%)
40	0
20	0
10	0
4.75	22.9
2.36	12.4
1.18	21.7
0.6	16
0.3	15.4
0.15	7.2
0.075	2.2
PAN	2.2

Sieve analysis showed that the soil sample can be classified under coarse-grained soil. As per the unified classification system (USCS), it is classified as poorly graded sand. The gradation curve is shown in Figure 2, and the results to classify the soil are given in Table 2.

Table 2 Result of Sieve Analysis of Soil Sample

Percentage gravel	**22.9%**
Percentage sand	**74.9%**
Percentage fines	**2.2%**
Coefficient of curvature	**0.895**
Uniformity coefficient	**7.89**

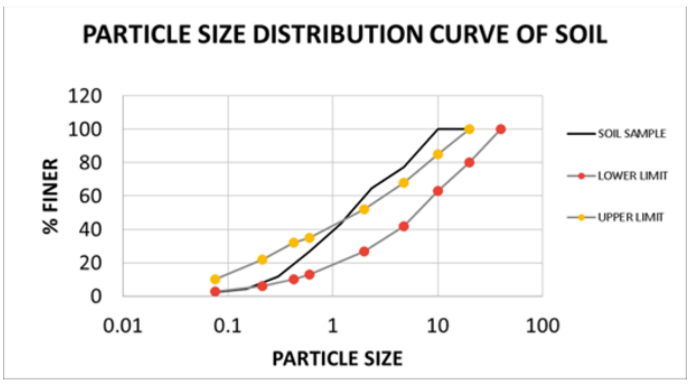

Figure 2 Gradation Curve of Soil Sample

3.1.2. Atterberg's limit test

Atterberg limit test results are shown in Figure 3 Flow Curve. The liquid limit is 48.014 %, plastic limit 41.86% and plasticity index 6.15%. For the obtained plasticity index blanket layer thickness needed is 45 cm.

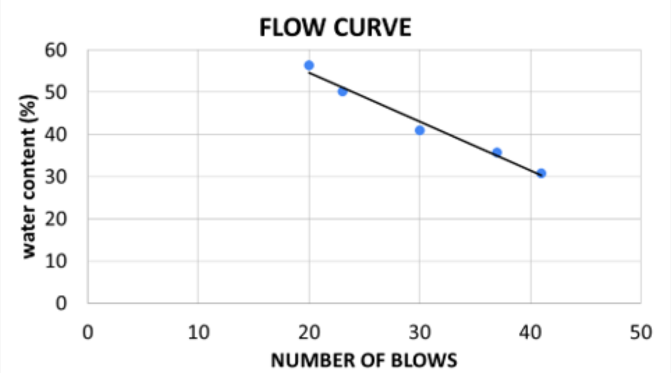

Figure 3 Flow Curve

3.1.3. Standard proctor compaction test

The standard proctor compaction test was conducted as per IS 2720 Part VII of the BIS specification. The optimum moisture content and maximum dry density obtained are 19% and 1.635g/cc. The compaction curve is shown in Figure 4.

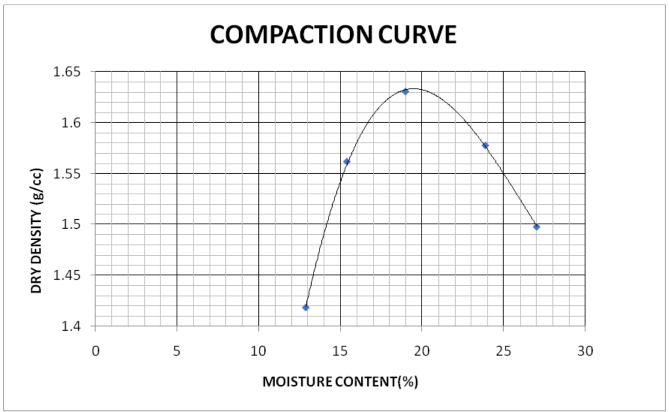

Figure 4 Compaction Curve of Soil Sample

3.1.4. California bearing ratio test

CBR test on soil was conducted according to the procedure conforming to the IS 2720 Part XVI of BIS specification and the observation is reported below in Figure 5.

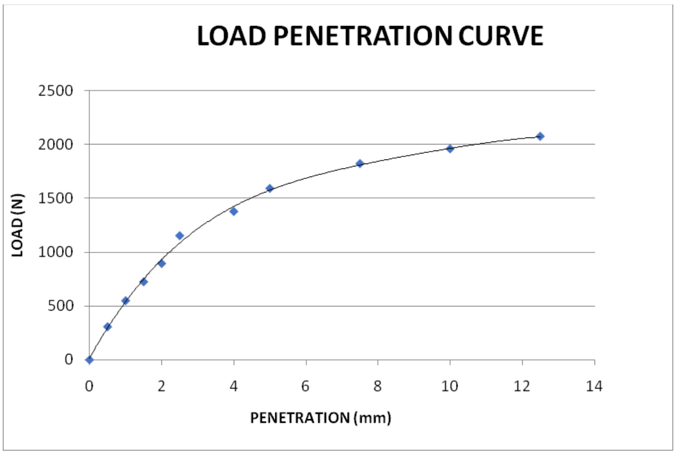

Figure 5 Load Penetration Curve

Table3 Result of CBR Test on Soil

CBR at 2.5 mm	**7.92%**
CBR at 5 mm	**7.68%**
Final CBR value	**7.92%**

3.2. Aggregates

Figure 6 Aggregate Sample

3.2.1. Sieve analysis

The grain size analysis of the aggregate sample was conducted according to the procedure conforming to the IS 2720 Part IV of BIS. The observation with the result is shown in Table 4and the gradation curve is shown in Figure 7.

Table 4 Observation Of Gradation Analysis Of Aggregates

Particle size (mm)	Percentage weight retained (%)
40	0
20	11.45
10	87
6.3	1.24
4.75	0
2.36	0
1.18	0
PAN	.15

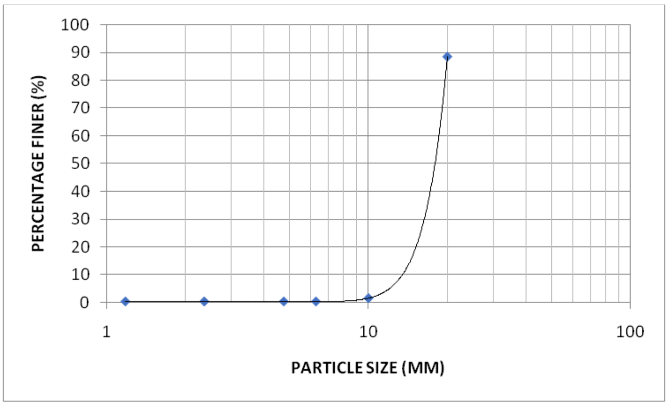

Figure 7 Gradation Curve of Aggregates

3.2.2. Los Angeles abrasion test

The abrasion test for the aggregate sample supplied was performed in Los Angeles Abrasion Machine conforming to the procedure specified by IS 2386 Part IV. The Abrasion value obtained is 34.4%.

3.3. Design mix of proportion soil: aggregate:: 75:25

3.3.1. Sieve analysis

The grain size analysis of the design mix of the proportion of 75% soil and 30% aggregate was conducted and the observation with the result is shown in Table 5 and the gradation curve is shown in Figure 8.

Table 5 Observation of Gradation Analysis

Particle size (mm)	Percentage weight retained (%)
40	0
20	4.55
10	30.1
4.75	13.2
2	18.25
0.6	13.6
0.425	6.55
0.212	6.5
0.075	3.55
PAN	3.7

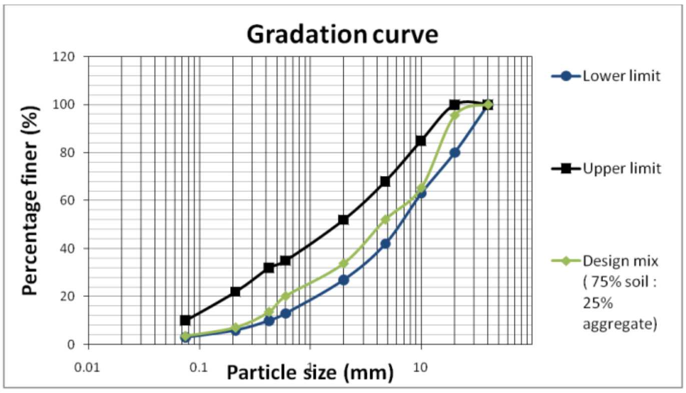

Figure 8 Gradation Curve of Design Mix

3.3.2. Heavy proctor compaction test

The heavy proctor compaction test was conducted as per IS 2720 Part VII of the BIS specification. The optimum moisture content and maximum dry density obtained are 14% and 1.825g/cc. The compaction curve is shown in Figure 9.

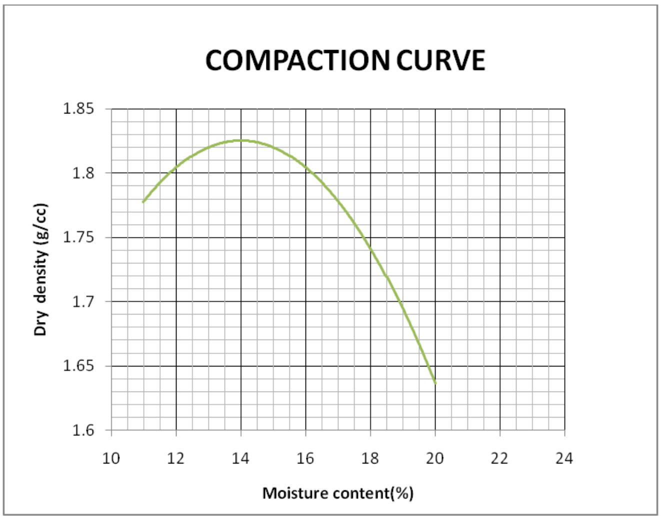

Figure 9 Compaction Curve

3.3.3. Soaked California Bearing Ratio test

CBR test on the design mix was conducted according to the procedure conforming to the IS 2720 Part XVI of BIS specification and the observation is reported below in Figure 10 and Table 6.

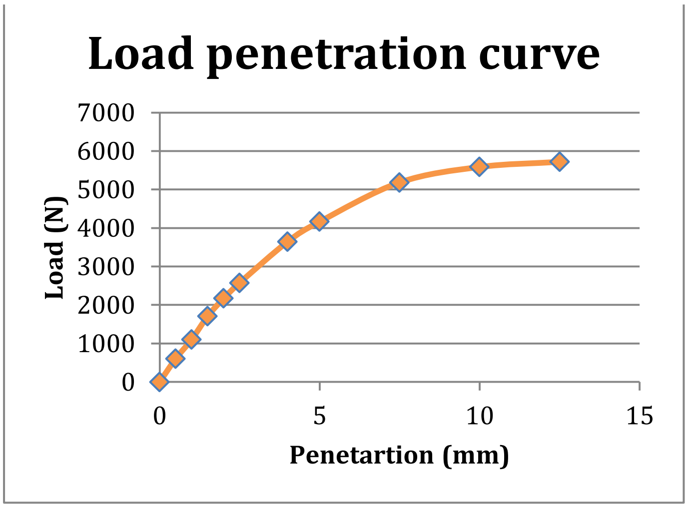

Figure 10 Load Penetration Curve

Table 6 Result of Soaked CBR Test on Design Mix

CBR at 2.5 mm	**18.73%**
CBR at 5 mm	**20.44%**
Final CBR value	**20.44%**

3.4. Design mix of proportion soil: aggregate:: 65:35

3.4.1. Sieve analysis

The grain size analysis of the design mix of the proportion of 65% soil and 35% aggregate was conducted and the observation with the result is shown in Table 7 and the gradation curve is shown in Figure 11.

Table 7 Observation of Gradation Analysis

Particle size (mm)	Percentage weight retained (%)
40	0
20	6
10	27.5
4.75	17.5
2	16.85
0.6	18
0.425	3
0.212	2.06
0.075	3.25
PAN	2.9

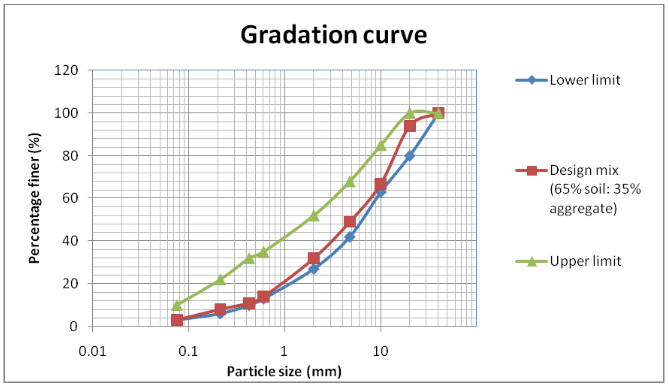

Figure 11 Gradation Curve of Design Mix

3.4.2. Heavy proctor compaction test

The maximum dry density obtained is 13.75 % and 1.91 g/cc. The compaction curve is shown in Figure 12.

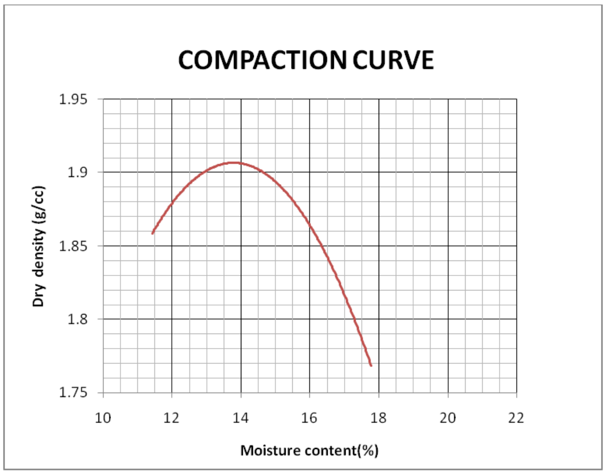

Figure 12 Compaction Curve

3.4.3. Soaked California Bearing Ratio test

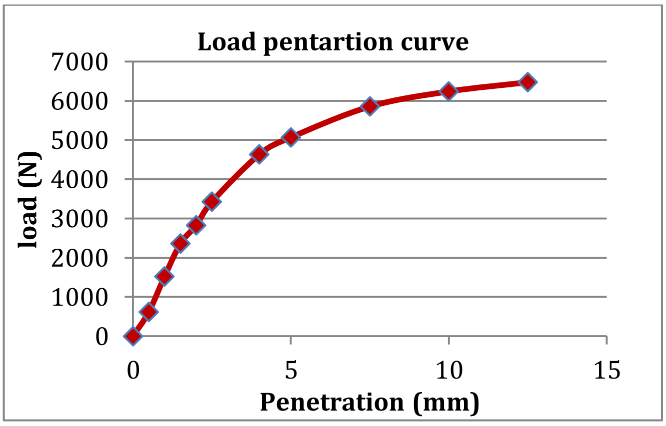

Figure 13 Load Penetration Curve

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 06 | June 2022 www.irjet.net p-ISSN: 2395-0072

Table 8 Result of Soaked CBR Test on Design Mix

CBR at 2.5 mm	**24.84%**
CBR at 5 mm	**25.2%**
Final CBR value	**25.2%**

3.5. Design mix of proportion soil: aggregate:: 70:30

3.5.1. Sieve analysis

The grain size analysis of the design mix of a proportion of 70% soil and 30% aggregate was conducted.

Table 9 Observation of Gradation Analysis

Particle size (mm)	Percentage weight retained (%)
40	0
20	8.4
10	22.6
4.75	15.4
2	15.8
0.6	21.2
0.425	4.9
0.212	4.2
0.075	4.5
PAN	3

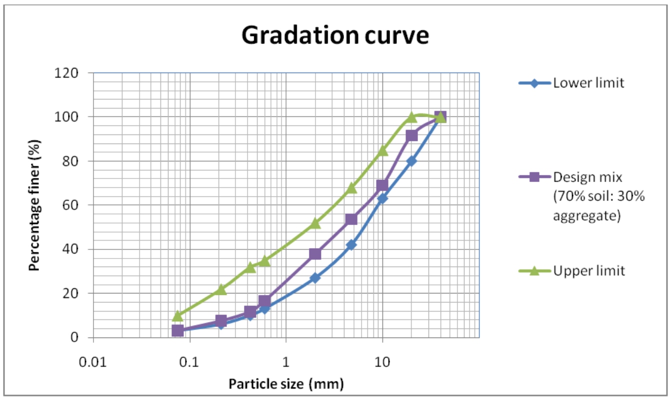

Figure 14 Gradation Curve of Design Mix

3.5.2. Heavy proctor compaction test

The optimum moisture content and maximum dry density obtained are 13.5 % and 1.885 g/cc. The compaction curve is shown in Figure 15.

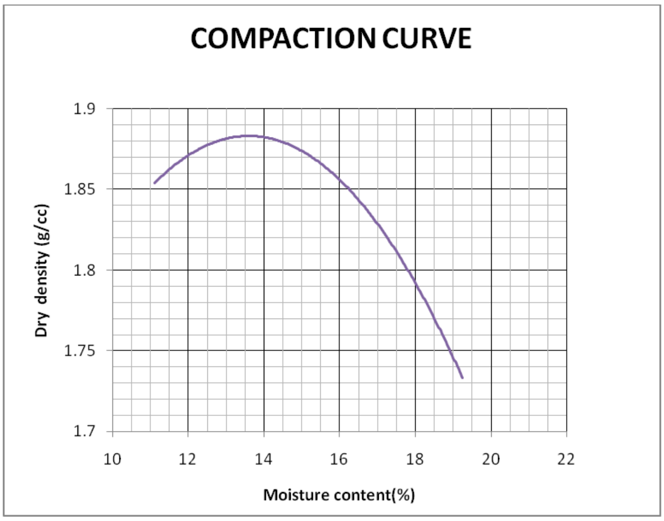

Figure 15 Compaction Curve

3.5.3. Soaked California Bearing Ratio test

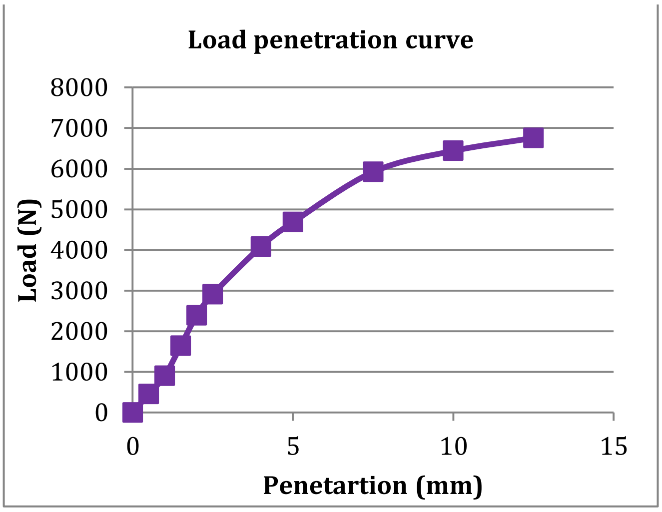

Figure 16 Load Penetration Curve

Table 10 Result of Soaked CBR Test on Design Mix

CBR at 2.5 mm	**21.16%**
CBR at 5 mm	**23.35%**
Final CBR value	**23.35%**

4. INTERPRETATION OF RESULTS

Table 11 shows the results obtained from the gradation analysis. From that, we can interpret that the proportions soil: aggregate::75:25 and soil: aggregate::65:35 are within the limit for well-graded soil.

Table 11 Result of gradation analysis

Proportion (soil: aggregate)	Coefficient of curvature	Uniformity coefficient
75:25	26.06	1.074
70:30	20.46	0.939
65:35	24.46	1.026

When we compare the compaction curves of three proportions the one with more percentage of aggregates gives the highest dry density. Figure 17 Comparison of Compaction Curves gives the comparison between the compaction curves. The optimum moisture content for every proportion is almost equal.

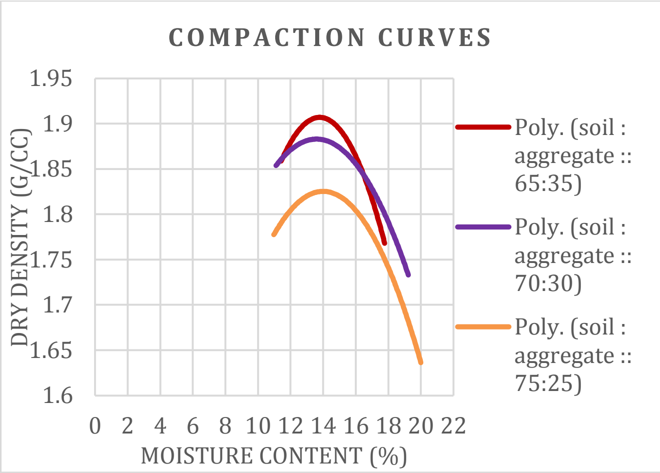

Figure 17 Comparison of Compaction Curves

From the analysis of load penetration curves of three proportions the soil: aggregate::65:35 gives the maximum California Bearing Ratio value. Figure gives the comparison between the load penetration curves.

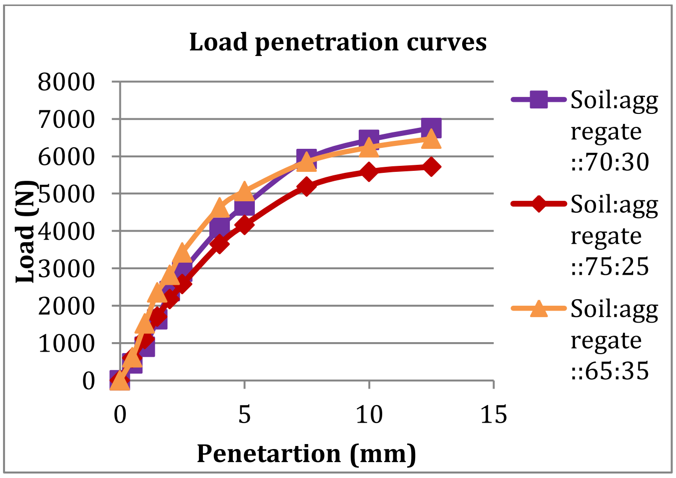

Figure 18 Comparison of Load Penetration Curves

The design mix with 65% soil and 35% aggregate by weight conform to the specifications for gradation and CBR value.

5. CONCLUSIONS

Soil and aggregate samples were collected from the site and all the necessary laboratory tests were conducted. After analyzing their properties, the soil sample failed to meet the mandatory specifications proposed for the blanketing material. So, we blend soil and aggregate in three different proportions (such as soil: aggregate 65:35, 70:30, 75:25) to choose the one which is best suitable for the design of the blanketing layer in all desired aspects. Later, Soaked California Bearing Ratio tests were conducted on each proportion after performing the preliminary tests required to determine their strength.

From the results obtained the following conclusion are drawn:

- With the addition of aggregate to soil, there is an increase in California Bearing Ratio value and hence an increase in strength can be observed.
- So to obtain a stronger blanketing material, the product obtained as the result of soil-aggregate mixing was found to be more effective than soil used alone.
- When the amount of adding aggregate increased considerably, it was found to be uneconomical.
- Hence 35% of the total weight of the mix can be taken as the optimum amount of aggregate.
- The soil: aggregate proportion of 65:35 also gives the higher California Bearing Ratio value as well as required California bearing ratio value.

Analyzing the above points we are finally arriving at the result that the mix proportion that meets all the criteria for designing a good blanketing layer is 65% soil and 35% aggregate. With this desired output we are concluding with the project works.

REFERENCES

[1]Research Design and Standard Organisation (2003)GUIDELINES FOR EARTHWORK IN RAILWAY PROJECTS Guideline No.GE: G-1 (including correction slip no. 1), Publication of Government of India, Ministry of Railway, Lucknow

[2]Research Design and Standard Organisation (2009) Guidelines and Specifications for Design of Formation for Heavy Axle Load RDSO/2007/GE:0014, Publication of Government of India, Ministry of Railway, Lucknow

[3] Shri Ashutosh Gupta, Dy C.E.(C), C.R., Shri S.S. Tomar/XEN (C), C.R., Shri Ashok Kumar J.E. (Works) (2015). Laying of Blanket for Nerul/Belapur-Seawood-Uran Railway Project, IRICEN Journal of Civil Engineering, Volume 8, No. 2

[4] Singh, H. (2021). Design of blanket by adding different percentages of soil. 77,459–465. https://doi.org/10.1007/978-981-15-5195-6_36