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Use of demolition brick and masonry wall to improve the CBR of Black Cotton Soil.

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Abstract
The second-largest economic activity in India is the construction sector. Regularly, new structures are built, and outdated ones are destroyed. The goal of this research is to strengthen poor soil, such as Black Cotton soil, by using the debris from demolished buildings that were collected from construction components. To improve the essential properties of poor soil, coarser building and demolition waste particles can be used in place of smaller ones. Use of appropriate waste materials as stabilizers can prove to be an efficient and cost-effective solution for stabilizing unstable soil. Testing is required for black cotton soil and debris from construction and demolition projects with grading between 2.36 and 4.75 mm.The best waste percentage to mix with soil for maximal strength enhancement can be determined by tests using different amounts of trash to soil (0%, 10%, 15%, 20%, and 25%). Black cotton soil has a low load-bearing capacity, is prone to swelling and shrinkage, and has a low shear strength, making construction over it a difficult task. It is customary to replace the entire soil for the construction of a high-rise building or pavement. For a low-rising building, primarily in rural regions, such complete replacements are typically expensive. Soil stabilization techniques can be used for such buildings to enhance the qualities of the soil by replacing a portion of it with other materials.
Key words *- Black cotton soil, C&D waste, shear strength, CBR test, index properties, consistency limits.*

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I. INTRODUCTION

The construction industry is India's second-largest economic sector after agriculture, according to the country's 11th five year plan. From 0.25 to 5.14 million tons of garbage are produced annually because of construction and demolition work. It will be reasonable to link building and demolition waste creation with Indian economic growth given the construction industries huge. Any physical, chemical, mechanical, biological, or combination method of modifying a natural soil to serve an engineering objective is referred to as "soil stabilization." To reinforce road pavements, improvements include raising the weight-bearing capacity, tensile strength, and general performance of in-situ subsoil's, sands, and waste materials. The cohesive soil used here is black cotton soil. For civil engineers, it is challenging or troublesome soil. It can swell during the rainy seasons and contract throughout the summer. It presents issues in both scenarios. When the Black Cotton Soil expands during the rainy season, the structure experiences uplift pressure, which causes heave in the foundations, plinth beams, first floors of buildings, canals, road surfaces, etc. When the soil contracts during the summer, walls, slabs, plinth protection, floors, etc. develop cracks due to shrinkage. Due to a higher percentage of clay, Black Cotton soil expands during the wet season. When it rains, it swells, and when it shrinks in the summer, it cracks. The fissures are typically between 0.5 and 2 meters deep and 100 to 150 millimeters wide. The Black Cotton soils have a very poor bearing capacity and are highly compressible. The soil has excellent qualities for shrinkage and swelling. The soil has a very weak shear strength. Expansive soil is another name for black cotton soil. Black cotton soils cover a sizable portion of central India as well as a portion of southern India, including Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, South Gujarat, and Uttar Pradesh. The area covered is about 3,000 square kilometers. The basalt or trap rock that formed these soils. Cotton can grow very well in these soils. The soil has a very low bearing capacity and are highly compressible. The building, remodeling, maintenance, and demolition of houses, big building structures, highways, bridges, piers, and dams' results in the production of construction and demolition (C&D) waste. Wood, steel, concrete, gypsum, masonry, plaster, metal, and asphalt are the main components of C&D waste. Because it may contain dangerous substances like

lead and asbestos, C&D trash is noteworthy. Although estimates vary, it is generally agreed that between 15% and 20% of municipal solid trash is generated by construction and demolition activities. Long term durability of pavement structures depend on the stability of the soils beneath. Earth materials below pavement do not always meet these requirements. So there is a need to change these less effective earth materials into sustainable sub grade materials. Stabilizing the poor soil such as black cotton soil with acceptable waste material as stabilizer could be an effective and economic method. The quantity of waste materials generated per annum from construction and demolition activities ranges from 0.27 to 5.18 million tons. It will be appropriate to link the generation of garbage from construction and demolition with the economic development of India, given the construction industry's rapid rise.

Therefore, in order to propose an economical method, adequate practices for the control of construction and demolition (C&D) waste are required. Probably one of the main factors affecting construction is the soil. Since everything is built on dirt, including houses and shopping malls, building foundations must be on firm soil. The strength of each type of soil varies, thus although some can support massive buildings, others cannot support the weight of a human. Soil stabilization is one of the particular building approaches needed for cotton chernozem, one of these soils. The process of employing stabilizers or additives to improve the engineering properties of soft soils is known as soil stabilization. Three primary approaches are used to stabilize soil: chemical stabilization, mechanical stabilization, and polymer stabilization.

Due to carbonation, sulfide attack, and other factors, these materials treat the soil and improve its workability and durability, but they have a negative impact on the environment. Thus, the primary goal of this research is to stabilize soil utilizing recycled C&D wastes while minimizing the negative environmental effects of carbonation, sulphide assaults, and unlawful dumping. Additionally, this will lessen the requirement for limited landfill space. Soil stabilizing chemicals have been used for a long time to increase strength and regulate volume change in weak foundation soil qualities. Al-Sharif et al. (2012) assessed burned sludge's suitability as a stabilizing agent. The sludge was burned at 550 °C and added to the three clay soil samples in different proportions. The result shows the addition of 7.5% burnt sludge ash (dry weight) increased maximum compressive strength, maximum dry density and minimized soil swelling pressure. Adding more than 7.5% by weight lowers both the maximum dry density and compressive strength of without limitation. Therefore, in this study, it was concluded that calcined sludge can be used as a soil stabilizer. Dhananjay et al. (2019) and Henzinger et al. (2015) conducted a black cotton soil stabilization experiment using demolition waste and concluded that the value of CBR increased as the amount of construction waste increased. His test results showed that the swelling pressure decreased rapidly as the EPS geofoam layer increased. Teja et al. (2018) analysed soil stabilization extending with brick dust.

I) Black cotton soil:

Expanding soil, another name for black cotton soil, is one of the most difficult soils to work with in building. Black cotton soils are heavy clay soils that vary in texture from clay to loam and are typically light to dark grey in color. They are primarily found in central and southern India. Broad dirt or black cotton shrinks, hardens into rock, and has a large carrying capacity as it gets dry. When wet, it swells, becomes extremely loose, and can no longer support a load. These soil types' basic mineralogical makeup, which is typically rich in the minerals montmorillonite and illite, has a significant impact on how they expand.

II) Objectives of soil stabilization:

- Increased shear strength
- Reducing permeability and shrinkage cracks
- Increased durability
- Erosion prevention

III) Construction and demolition waste:

- C and D waste constitutes a major portion of total solid waste production in the world, and most of it is used in landfill.
- In India, it is very common to see huge piles of C and D waste, stacked alongside of major roads resulting in traffic jams and chocking of drains.
- There are different aspects of the problem beginning with a brief review of the INDIAN scenario in terms of C and D waste generated.

II. AIM AND OBJECTIVES

Aim: Use of demolition brick and masonry wall to improve the CBR of black cotton soil.

Objectives:

- To reuse the demolition brick and masonry wall.
- To improve the CBR of black cotton soil.
- To increase the strength of soil.

III. LITERATURE REVIEW

- Title - Improvement in CBR of Black Cotton Soil Using Brick Powder (Demolition Brick Masonry Waste) and Lime.
  Author- Ms Akshatha R1, Mr Bharath H M2
  Conclusion- After discussion, it may be determined that using BP with BC soil will improve the soil CBR values. Brick Powder was found to be cost-effective for the area and made use of demolition waste. As a result, the rejected black cotton soil will be used for construction. Based on the findings, it can be said that brick powder and lime have a favorable impact
- Title - Research on 'Effects of Construction and demolished waste on strength parameters of Black cotton soil
  Author-Shreyash Dilip Makode, Pawan Sanjay Mokle, Samrat Lalasaheb Patil, Yuvraj Dhansingh Badhiye,
  Conclusion- The objective of this study is to use the debris to fortify weak soil, such as Black Cotton soil. From construction materials that were gathered from demolished buildings. Coarser building and demolition debris particles could be employed in place of smaller ones to improve the requisite qualities of poor soil. Utilizing suitable waste materials as Stabilizers may prove to be a successful and affordable method of stabilizing brittle soil. Debris testing is necessary. Between 2.36mm and 4.75mm in grade, from building and demolition operations, especially on black cotton soil. The top Tests with various amounts of garbage can be used to establish the waste percentage to combine with soil for maximum strength development. (0%, 10%, 15%, 20%, and 25%) to soil.
- Title- Use of Recycled Construction and Demolition (C&D) Wastes in Soil Stabilization.
  Author -S. P. Sangeetha†, Zhimoholi T. Chophi, Pooja Venkatesh and Muhammad Fahad
  Conclusion- The use of C&D wastes as a soil stabilizer has been researched before, and the findings of this study are consistent with those of previous research studies, demonstrating the viability of this usage.With the use of recovered C&D wastes, we attempted to enhance the engineering qualities of black cotton soil in this study.
- Title - Study on stabilizing black cotton soil with over burnt brick powder and lime.
  Auhor- Nikhil Tiwari, Shriyanka Prajapat, C.D.Prasad
  Conclusion- The findings suggest that lime and burnt brick powder have a certain and beneficial effect on black cotton soil.By replacing soil with 5% lime and almost 35% burnt brick powder of its dry weight, it produces dramatic alteration in the black cotton soil's building characteristics. Use of powdered burned brick as well as Lime is the ideal adjusting material since it works well as a stabilizer and is also a waste utilization. The CBR value increases by up to 1000% when burnt brick powder and lime are used. It was discovered that the qualitative features of the lime and block tidy mixture changed in an astonishing way when compared to lime/burnt brick powder alone. The conclusions are based on tests that were conducted using different burnt brick powder and lime mixtures chosen for the same. It has been observed that adding lime and consumed burnt brick powder to 6% lime &25% brick powder reduces differential free swelling rundown and fluid breaking point. The ideal estimation of most outrageous dry thickness and the unrestricted compressive strength increases astronomically with increasing amount of block tidy and lime up to 6% lime &25% brick dust.
- Title - Use of Recycled Construction and Demolition Waste Material in Soil Stabilization.
  Author - Rajiv Pazare, Gaurav Yede, Ayush Lonare, Aniket Khawshi , Nayna Charmode , Ashutosh Ingle
  Conclusion- The goal of this study was to improve the black cotton soil's engineering qualities while also lowering its potential for swelling and raising its load-bearing capability. The effects of other additions, including as lime, rice husk ash, cement kiln dust, etc., for soil stabilization have been examined in the past, however the majority of these led to excessive heaving and pavement failures. The use of C&D wastes as a soil stabilizer has been researched before, and the findings of this study are consistent with those of previous research studies, demonstrating the viability of this usage. With the use of recovered C&D wastes, we attempted to enhance the engineering qualities of black cotton soil in this study. The aforesaid

observations lead to the conclusion that cotton soil has greatly better engineering qualities. Cotton in construction is a problem that can be resolved by using C&D waste as a soil stabilizer.

- Title - Study on Improvement of Black Cotton Soil by Using Fines of Concrete Cube & Brick Demolition Waste.
  Author - Chakure Shivakumar, Bolle Srikanth, Kancharidasu Sunny Kumar and Niteen Keerthi
  Conclusion - Adding fines to Black Cotton soil is the first method for increasing its strength. a successful mixture of Black Cotton soil and Concrete Cube Waste (FCCW). The Black Cotton soil's density grew in tandem with a rise in the proportion of FCCW and then a decline. With a rise in temperature, BC soil's Optimal Moisture Content (OMC) marginally reduced increase in the percentage of FCCW afterwards.
  Nevertheless, in view of the research that have been done, the 20% of FCCW is thought to be the ideal proportion of the FCCW, producing the most strength and performance as seen in the UCS test results. The second strategy involves enhancing the Black Cotton soil's strength property by adding Fines of Brick Demolition Waste (FBDW), which was only assessed based on compaction characteristics. With a rise in the amount of FBDW and a subsequent drop, the density of the Black Cotton soil also increased.
- Title - Lime-Stabilized Black Cotton Soil and Brick Powder Mixture as Sub base Material.
  Author - S. Srikanth Reddy, A. C. S. V. Prasad, and N. Vamsi Krishna
  Conclusion - The following conclusions can be made from the study done on brick powder and lime stabilized black cotton soil mixture:
  (1) The strength parameters of the black cotton soil under study were enhanced by lime stabilization, but not to the point where it was suitable as sub base material.
  (2) In compared to 4% lime stabilized soil, the maximum dry density was increased and the optimal moisture content was decreased when 20% brick powder and 80% lime-stabilized black cotton soil were combined.
  4) Because brick powder is inexpensive and widely available, using it lowers the amount of lime in a project. Additionally, using brick powder lessens the issue of trash disposal.
  Therefore, in rural locations where brick powder is readily available in large quantities as well as in areas with a dearth of good quality materials, a blend of brick powder and lime-stabilized black cotton soil can be effectively employed as subbase material for extensible pavements.
- Title - Use of Construction and Demolition Waste for Ground Improvement.
  Author - Pratik Patil, Prakash Panda, Mehul Neman, Sangram Mhetre
  Conclusion - There is an increase in the soil's capacity to bear loads with the addition of construction waste, and this capacity is at its highest when the replacement of soil is 10%, according to tests that were conducted with various proportions of construction waste replaced by black cotton soil. Thus, it can be said that stabilizing the soil by adding 10% building rubble to it increases its strength and load-bearing capacity for the poor black cotton soil. The expansive soil that exists 1 m below the foundation level and 1 m outside the boundaries of the one-story building is removed and rebuilt for increased stability.
- Title - Soil Stabilization by Using Brick Powder.
  Author - Mr. Kalpesh Aware, Dr. Satish B. Patil, Prof. Avinash Rakh
  Conclusion - On the basis of research and experimental examinations, it was determined that varying amounts of brick powder increased the qualities of black cotton soil. It was discovered that with adding of brick powder in different proportions to black cotton soil, liquid limit showed a decreasing trend. Therefore, it can be inferred from this study that a minimum brick powder content of 10% can be used to enhance the qualities of BCS, and even this percentage can be chosen for reasonably priced pavement construction.
- Title - Study on Stabilization of Soil Using Burnt Brick.
  Author - Prof. S.S. Razvi, Deepak Nannaware, Shubham Bankar, Atul
  Conclusion- The test conducted on the soil chosen for the study served as the foundation for the conclusion. The waste material that was taken out of the brick kiln and is useful as a soil stabilizer. When waste products are used properly, soil is stabilized and strengthened Burnt Brick Bat is readily accessible and typically fairly inexpensive. Burnt brick can occasionally be obtained for no charge from early brick kiln. Burnt brick bat can be used as a soil stabilizer in earth soils to improve the soil's engineering qualities. The quality and strength of the soil will be higher compared to plain soil as the strength of the soil rises with the addition of ASH.
- Title - Review of Brick Waste in Expansive Soil Stabilization and Other Civil Engineering Applications.
  Author - Ali Al-Baidhani* 1, Abbas Al-Taie2
  Conclusion - Brick waste has been applied in numerous civil engineering applications in the form of crushed aggregates, dust, and brick powder. The ideal content, which typically ranged from 40% to 50%, is where brick waste may be stabilized most effectively. When applying brick waste to soil stabilized with other materials like cement, lime, or fly ash, a lower brick percentage is actually needed as an ideal content. However, factors like soil type, initial soil state, soil composition and its mineralogy, etc., affect the

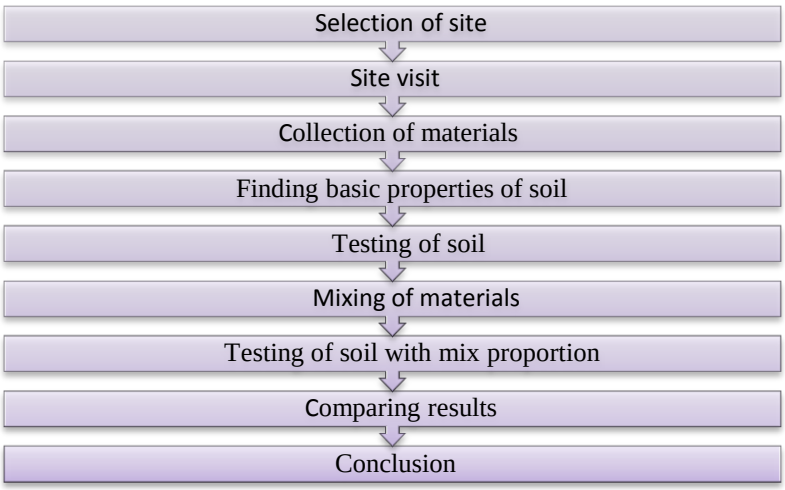
efficiency and content of brick waste. In terms of lowering the free swell index, liquid limit, plastic limit, plasticity index, soil shrinkage, and swelling potential, expansive soil treated with brick waste showed encouraging results.

The effectiveness of brick waste as a filler and pozzolanic material is the cause of its favorable response. Chemical reactions are happening with soil constituents.

Although the majority of research has focused on how brick debris affects soil strength and physical characteristics, consolidation, permeability, and durability have sadly received far less attention.

- Title - Stabilization of Black Cotton Soil by Using Construction and Demolition Waste.
  Author - 1A. S. Dhananjaya, * 2 Tushar G. Warade, 2Ankit S. Wankhede, 2 Shubham N. Raghuvanshi, 2Kishor H. Tandale
  Conclusion - The goal of our experimental study on the black cotton soil was to improve its engineering properties, increase its capacity for carrying loads, and reduce swelling. In our experimental study, we also added C&D waste material in varying amounts to see how it affected the engineering properties. We saw that the results we obtained agreed with those of other researchers who had carried out the same study using a different kind of reinforcing material. We found that using construction and demolition waste material can increase the CBR value and load carrying ability of black cotton soil.

IV. METHODOLOGY



4.1Selection of site:

- We had visited panvel city for construction and demolition waste.
- We had survey of that site.

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Figure no.01– selection of site

4.2 site visit:

- Demolition work was going on site.
- From site survey we observed that there was more C and D waste.
- We talked to contractor and give information about our project.

Figure no.02- C and D waste

4.3 collection of materials:

- We collected construction and demolition waste from that site.
- We collect concrete bricks, tiles, plaster waste and bricks, etc.

Figure no.03- Collection of materials

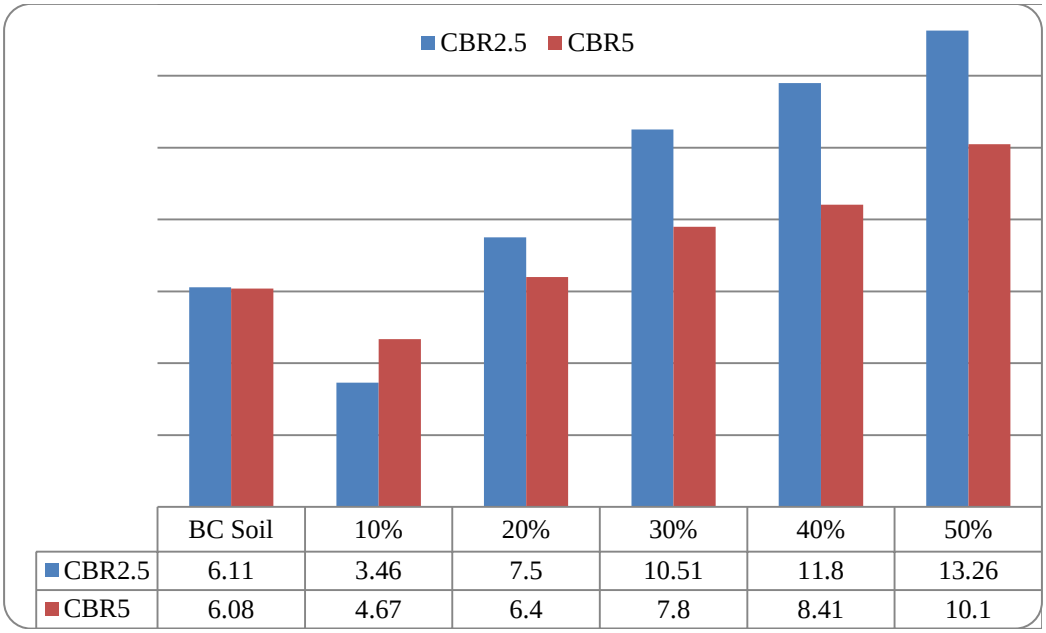
4.4 Finding basic properties of soil:

- Sieve analysis of soil.
- Determination of water content of soil.
- Determination of specific gravity of soil by pycnometer.
- Liquid limit and Plastic limit of soil.
- Standard proctor test (OMC and MDD).
- CBR Test.

V. RESULTS & DISCUSSIONS

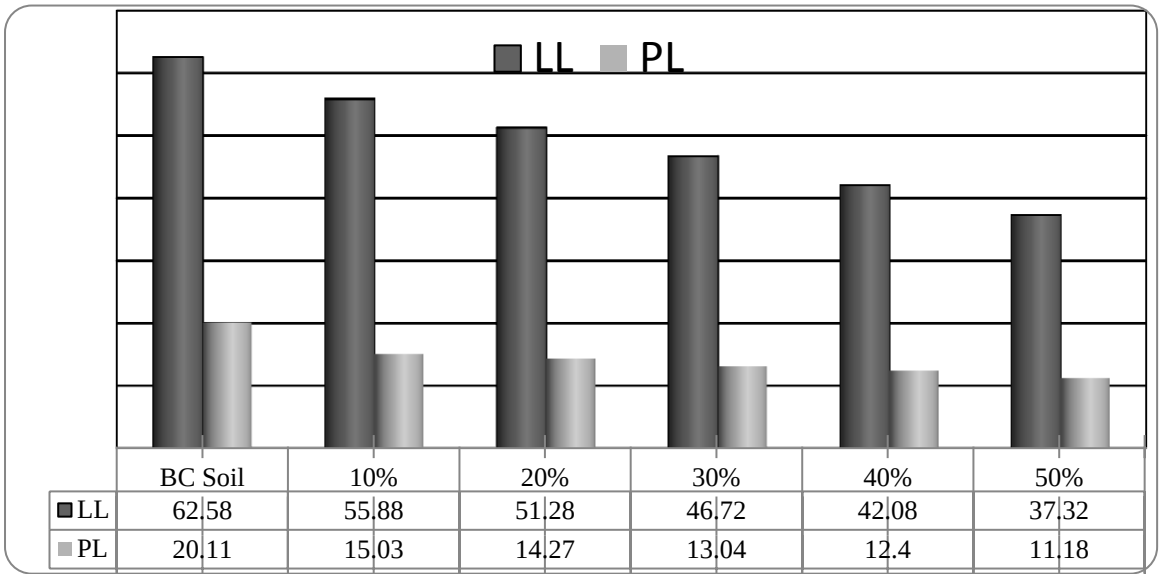
SR.NO	PROPERTIES	VALUE OF BC SOIL	10% C&D WASTE	20% C&D WASTE	30% C&D WASTE	40% C&D WASTE	50% C&D WASTE
1	Liquid limit	62.58%	55.88%	51.28%	46.725	42.08%	37.32%
2	Plastic limit	20.11%	15.03%	14.27%	13.04%	12.37%	11.18%
3	Plasticity index	42.47%	40.85%	37.01%	33.68%	29.71%	26.14%
4	MDD	1.17gm/cc	1.47gm/cc	1.54gm/cc	1.45gm/cc	1.32gm/cc	1.48gm/cc
5	OMC	18.06%	11.15%	18.18%	20%	20%	20.83%
6	CBR 2.5	6.11%	3.46%	7.055	10.51%	11.8%	13.26%
7	CBR 5	6.08%	4.67%	6.405	7.80%	8.41%	10.10%

CBR RESULTS



	BC Soil	10%	20%	30%	40%	50%
CBR2.5	6.11	3.46	7.5	10.51	11.8	13.26
CBR5	6.08	4.67	6.4	7.8	8.41	10.1

LIQUID LIMIT & PLASTIC LIMIT RESULTS



	BC Soil	10%	20%	30%	40%	50%
LL	62.58	55.88	51.28	46.72	42.08	37.32
PL	20.11	15.03	14.27	13.04	12.4	11.18

VI. CONCLUSION

We observed that the CBR value of Black cotton soil can be improved by the use construction and demolition waste material. The plastic limit of black cotton soil was observed to be reduced after the addition of C & D waste. The liquid limit was also observed to be decreases when C&D waste was added to the black cotton soil. The strength of black cotton soil is increased up to 13.26 for 50% of C&D material used for stabilization of Black cotton soil which is our assumed expected outcome for the research. Therefore, the optimal percentage of C&D waste is 50% as it provides the highest CBR value.

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