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INVESTIGATION OF SOIL PROPERTIES IN VARIOUS LOCATION

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Abstract - This study examines the geotechnical properties of soils from four distinct locations in the Konkan region—Khopoli, Rasayani, Mangaon, and Uran—through a series of laboratory and field tests. Tests included water content determination, specific gravity, sieve analysis, Standard Proctor compaction, direct shear tests, and core cutter methods. Key parameters such as optimum moisture content (OMC), maximum dry density (MDD), particle size distribution (D10, D30, D60, Cu, Cc), cohesion, and angle of internal friction were evaluated. Terzaghi's bearing capacity theory was applied to calculate ultimate bearing capacities for square footings, revealing significant variability: Khopoli (640.80 kN/m²), Rasayani (1741.026 kN/m²), Mangaon (2065.571 kN/m²), and Uran (2164.039 kN/m²). These results highlight the necessity of site-specific soil investigations for safe and economical foundation design in regions with diverse geological conditions.

Key Words: Geotechnical Properties, Soil Bearing Capacity, Konkan Region, Sieve Analysis, Standard Proctor Test, Direct Shear Test, Terzaghi's Theory, Soil Variability, Foundation Design, Cohesion and Friction Angle

1. INTRODUCTION

Soil forms the foundation of all civil engineering projects like dam, bridge, building, tunnel, etc. making its study essential for the safe and efficient design of structures. Variability in geological conditions, such as hilly terrains, coastal zones, and urban regions, significantly influences soil properties, affecting construction suitability and long-term stability. Despite its importance, comprehensive soil property data for specific regions is often unavailable. This project seeks to address this gap by systematically evaluating soil properties from selected locations to contribute to a database that supports engineering and environmental planning.]

A. Objectives

- To analyze soil properties changes in different locations
- To compare soil properties changes in different locations
- To characterize soil properties
- To collect soil samples from diverse regions, including urban and coastal areas.
- To evaluate soil properties using standardized laboratory and field methods.
- To compute soil bearing capacities and analyze variability in soil performance.

2. LITERATURE SURVEY

G. O. Adunoye, A. O. Oyelere and M. T. Oladepo [6] investigated some soil samples from selected sites were predominantly well-graded sands (SW) or poorly graded sands (SP). Square footings consistently provided the highest bearing capacities (269.12–3340.85 kN/m²), followed by circular and strip footings. The study highlighted that soil type and footing shape are critical determinants of bearing capacity

A. Shafaghat, H. Khabbaz, S. Moravej, Ah. Shafaghat [5] investigated the effect of footing shapes (square, circular, strip, and ring) on sandy soil bearing capacity.Results demonstrated that square and circular footings provided higher capacities compared to strip and ring footings. The bearing capacity improved with spacing and shape optimization.Circular footings exhibited reduced capacity under close spacing, while square footings showed consistent performance.

Surendra Roy and Sanjeev Kumar Bhalla [4] investigated and geotechnical properties, such as specific gravity, shear strength, and permeability, were identified as key determinants of structural stability. Cohesion and angle of internal friction (ϕ) were highlighted as critical for predicting bearing capacity. Compaction and proper assessment of soil plasticity were deemed essential for foundation performance.

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Mr. Umesh N. Waghmare' and Dr. K. A. Patil [3] carried out geotechnical investigations and revealed that square-shaped footings performed best, with a significant increase in bearing capacity at greater depths.For cohesive soils, the transition from local to general shear failure at increased depths accounted for higher capacities.This study reinforced the role of soil type and footing shape in achieving efficient foundation designs.

M.S. Dixit and K.A. Patil [2] investigated factors such as soil type, footing depth, width, and water table position were analyzed.Increased footing depth and width generally enhanced bearing capacity, while a rising water table significantly reduced capacity, particularly in non-cohesive soils.The importance of correcting for water table effects during foundation design was emphasized.

3. METHODOLOGY

A. Sample Collection

In this project, we had investigated the geotechnical properties of soils collected from various locations in konkan region. The work involves:

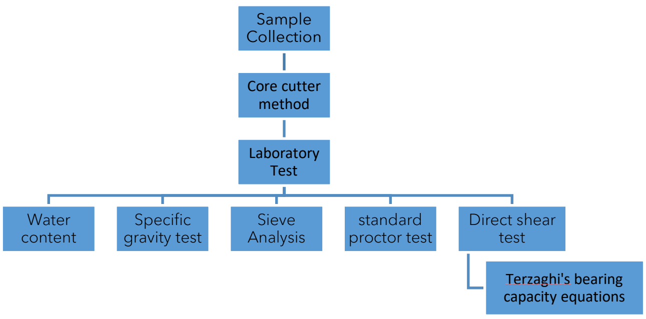


Figure Error! No text of specified style in document.**-1 Flow Chart**

Soil samples were collected from four key Locations:

Rasayani – Konkan coastel Plains. – 0 km

Khopoli – Urban and coastal area. – 22 km

Mangaon – Konkan division. – 87 km

Uran – Konkan division. – 48 km

Figure Error! No text of specified style in document.**-2 Location in GPS**

Soils where collected by using Core Cutter Apparatus from natural ground level about 5 to 10kg from location was collected and placed in polythene bag , well sealed, and immediately taken to Geotechnical Engineering Laboratory.

representative samples were taken for natural moisture content determination (using the oven method), while the remaining soils were air-dried and oven dried for subsequent laboratory tests and analyses

B. Laboratory test

1) Water Content Test.
2) Specific Gravity Test
3) Sieve Analysis
4) Standard Proctor Test
5) Direct Shear Test.

C. Analyses for bearing capacity

Equation For general shear failure Square footings.

$$Q_u = 1.3\, c\, N_c + \gamma\, D\, N_q + 0.4\, \gamma\, B\, N_\gamma$$

where,

C: Cohesion of soil (apparent cohesion intercept);

γ: unit weight of soil;

D: depth of footing

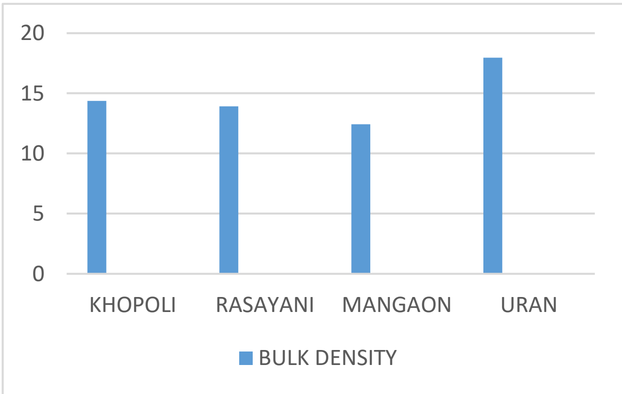
B: width/breadth of footing

Nc, Nq, Nr: Terzaghi's bearing capacity factor

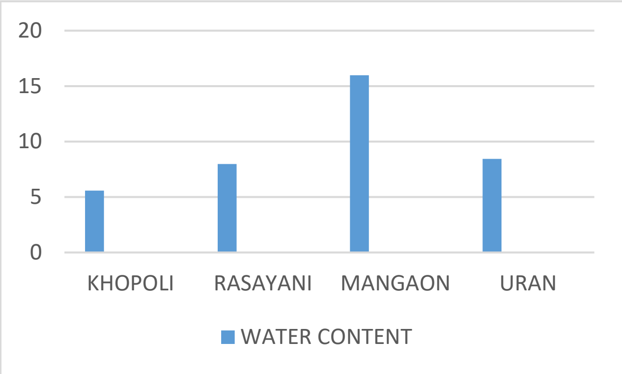
4. RESULTS

Following are the results from various tests and analyses.

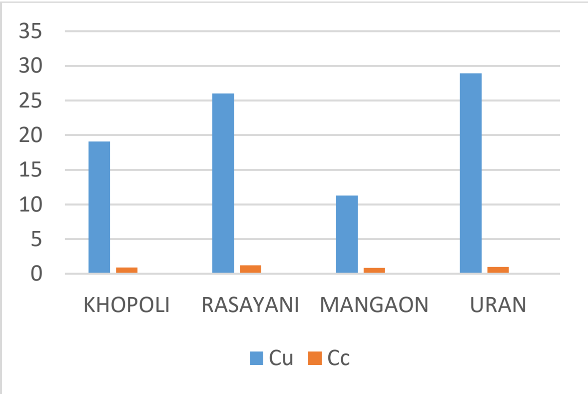
A. Bulk Density



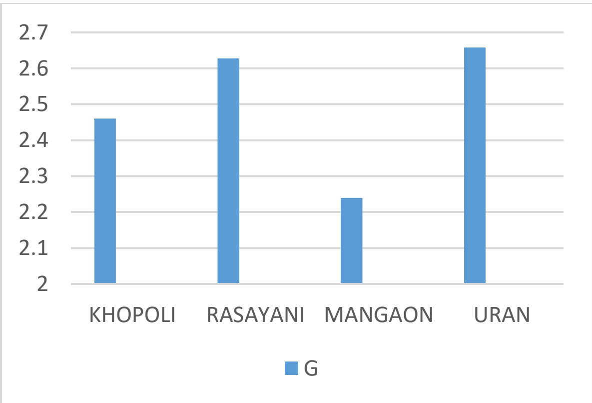
B. Water content



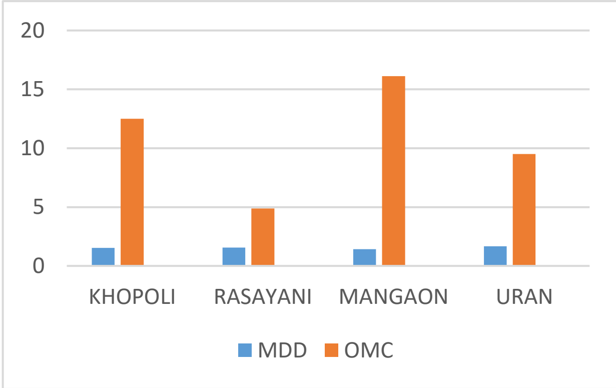
C. Coefficient of Uniformity and Coefficient Curvature



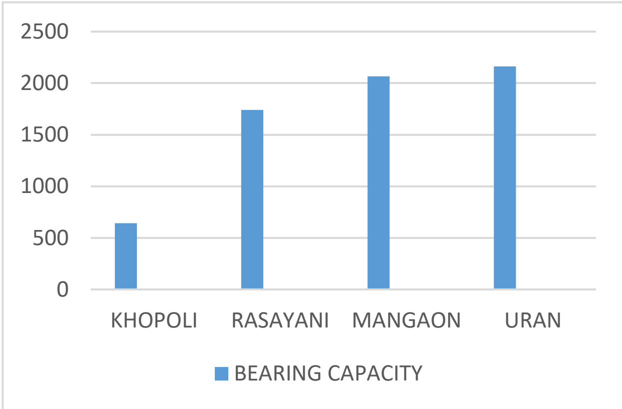
D. Specific Gravity



E. Maximum Dry Density And Optimum Moisture Content



F. Bearing Capacity



5. Table 1 Results of experimented results

	Khopoli	Rasayani	Mangaon	Uran
Water content % (W)	5.591	7.963	15.969	8.449
D_{10}	0.200	0.300	0.293	0.160
D_{30}	0.837	1.684	0.915	0.855
D_{60}	3.826	7.811	3.313	4.633
C_u	19.094	26.003	11.308	28.933

C_c	0.913	1.208	0.863	0.986
Specific Gravity (G)	2.46	2.628	2.24	2.658
MDD	1.528	1.557	1.432	1.677
OMC	12.5	4.87	16.12	9.52

Soil location	Cohesion, c (kN/m^2)	Internal friction angle, Ø (^{0})	N_c	N_q	N_γ	γ(kN/m^3)	Bearing capacity (kN/m^2)
Khopoli	0.568	32.508	46.106	30.412	29.456	14.38	640.80
Rasayani	9.71	35.795	62.938	46.574	53.443	13.93	1741.026
Mangaon	6.42	38.988	85.868	70.501	94.832	12.44	2065.571
Uran	2.84	38.666	83.141	67.583	89.545	17.96	2164.039

6. CONCLUSION

- Density of Soil Sample of Khopoli, Rasayani, Mangaon, Uran is 14.38 kN/m3, 13.93 kN/m3, 12.44 kN/m3, 17.96 kN/m3, respectively.
- Water Content of Khopoli, Rasayani, Mangaon, Uran Soil Sample is 5.591%, 7.963%, 15.969%, 8.449%, respectively.
- Coefficient of Uniformity (Cu) and Coefficient of Curvature (Cc) of Khopoli, Rasayani, Mangaon, Uran Soil Sample is 19.094 And 0.913, 26.003 and 1.208, 11.308 and 0.863, 28.933 and 0.986, respectively.
- Specific Gravity of Khopoli, Rasayani, Mangaon, Uran Soil Sample is 2.46, 2.628, 2.24, 2.658, respectively.
- Maximum Dry Density (MDD) and Optimum Moist Content (OMC) of Khopoli, Rasayani, Mangaon, Uran Soil Sample is 1.528 and 12.5, 1.557 and 4.87, 1.432 and 16.12, 1.677 and 9.52, respectively.
- Cohesion, c and Internal friction angle, Ø of Khopoli, Rasayani, Mangaon, Uran Soil Sample is 0.568 kN/m2 and 32.508, 9.71 kN/m2 and 35.795, 6.42 kN/m2 and 38.988, 2.84 kN/m2 and 38.66, respectively.
- Bearing Capacity of Khopoli, Rasayani, Mangaon, Uran Soil Sample is 640.80 kN/m2, 1741.026 kN/m2, 2065.571 kN/m2, 2164.039 kN/m2
- Khopoli soil is poorly graded sand and organic soil requiring soil improvement (e.g., compaction or stabilization) to support heavier loads.
- Rasayani soil is well graded gravel, sand type soil offers a balanced combination of frictional and cohesive strength, making it versatile for various civil engineering structures.
- Mangaon soil indicates a poorly graded sandy soil where strength is driven by particle interlocking and frictional resistance, making it suitable for heavy structures.
- Uran soil indicates a poorly graded sandy soil, the combination of high density and frictional strength makes this soil ideal for supporting heavy infrastructure, as it can withstand substantial loads with minimal settlement risks.

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