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REVIEW ON: FOUNDATION ANALYSYS OF RESIDENTIAL BUILDING AT BHUGAON

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Abstract: The subject of strength and total structural load is presented, accompanied by a formula that assesses the stability of rock foundations. Designing foundations for large structures is a complex and time-consuming task due to the numerous load combinations and simultaneous influences from various types of equipment and installations. The success of local economies relies on the reliability of these engineering structures. Regardless of the soil conditions, all buildings are classified into the third geotechnical category due to the substantial investments and high costs involved. The foundations of buildings must meet or exceed safety standards, ensuring effective communication between the equipment and nearby objects. It is crucial to adhere to stringent requirements regarding overall vertical displacement of the foundation and differential settlements between different foundation locations, guaranteeing optimal performance of the equipment. Experimental determination of rock qualities, such as compressive strength, and comprehensive structural load calculations are performed to analyze the strength of foundations.

***Index Terms* - Rock qualities, Compressive strength, Structural load calculations, Foundational strength analysis.**

1 INTRODUCTION

The inaugural Conference on Rock Mechanics was organized by the International Society for Rock Mechanics in 1966 in Lisbon. The definition of rock mechanics was established by the Committee on Rock Mechanics of the Geological Society of America in 1964, followed by the Committee on Rock Mechanics of the National Academy of Sciences in 1966.

Rock mechanics is a field that encompasses both theoretical and applied sciences, focusing on the behavior of rock in response to its environmental conditions. These principles are applicable to various types of excavation, including both surface and underground operations. Rock mechanics plays a vital role in mine planning and design, including the selection of mining methods, determination of optimum slope angles, design of support systems, and establishment of drilling and blasting parameters. Another aspect of rock mechanics pertains to the engineering properties of rock and the application of this knowledge to address problems related to rock materials. Geotechnical studies are necessary for underground structures in rock, which refer to any naturally occurring or excavated subsurface openings supported primarily by the surrounding rock and not by additional support systems within the openings. To ensure proper design and stability evaluation of such structures, it is crucial to determine the stresses and deformations induced by external or body loads and assess the structure's ability to withstand these stresses and deformations.

1.1 Rock Material Classification

The process of rock material classification involves several steps, including the identification of rock units at the investigation site, describing them using appropriate classification elements, and conducting a performance assessment. The performance assessment entails establishing the desired performance objectives for the intended engineering applications of the rock and classifying the rock material based on these objectives.

Identification of rock units:

A. Describing rock units using classification elements:

i) Rock material properties

ii) Rock mass properties

iii) Geohydrologic properties

B. Selection of performance objectives:

i) Hydraulic erodibility in earth spillways
ii) Excavation characteristics
iii) Construction quality
iv) Fluid transmission
v) Rock mass stability

To ensure proper design and evaluate the stability of underground structures, it is essential to have knowledge of the mechanical properties of the rock. These properties provide insights into how the material deforms or fails when subjected to external forces. The mechanical properties include tensile strength, compressive strength, shear strength, creep or time-dependent properties, and strain or deformation properties. Static testing methods can be employed to determine these mechanical properties, such as uniaxial (unconfined) compressive, tensile, shear, and flexural strength, as well as triaxial compressive and shear strength. Additionally, elastic constants, such as the modulus of elasticity and Poisson's ratio, can be obtained from the stress-strain relationship using uniaxial and triaxial testing methods.

1.2 Problem Statement

Traditionally, civil and military engineers have been involved in studying the mechanics of rock behavior for various projects, such as constructing deep foundations for dams, buildings, and bridges, creating rock cuts for highways, railways, and canals, and building rock tunnels for power supply or vehicular use. Similarly, mining engineers have a strong interest in understanding the behavior of the surrounding rock in their operations for extracting materials from beneath the Earth's surface.

Exploratory drilling provides the initial physical evidence in the form of rock cores, which offer insights into the nature of the subsurface rock. These cores contain intact rock materials and provide indications of existing discontinuities. Therefore, accurately classifying these cores is an important step in comprehending the expected behavior of the rock during and after construction.

Designing a structure in rock poses several challenges, including:

- Limited availability of information on the mechanical properties of in-situ rocks prior to underground excavation.
- Difficulties in calculating the stress and deformation in different parts of the rock structure.
- Determining the appropriate methodology for calculating structural loads in reinforced concrete structures.

1.3 Objectives

- To check the quality of underground rock.
- To suggest the suitability of foundation type for the proposed site.
- To test the strength of foundational rock.

1.4 Future Scope

The present study will help for future various activities in the design of foundation, which are listed as below.

- underground strata analysis.
- to suggest the type of foundation.
- it will ensure the safety of residential buildings.
- it will be helpful for slope stability analysis.
- in knowing the quality of rock engineering properties

1.5. Significance and Use

I. The Rock Quality Designation (RQD) is a cost-effective and straightforward method used to assess the quality of rock masses and predict tunneling conditions and support requirements. The practice of recording the Rock Quality Designation (RQD) has gained widespread acceptance in drill core logging for a variety of geotechnical investigations.

II. RQD values serve as a foundation for making initial design decisions, such as estimating the required excavation depths for structure foundations. Furthermore, the utilization of RQD values can assist in identifying potential concerns related to bearing capacity, settlement, erosion, or sliding in rock foundations. These values also serve as an indicator of rock quality in quarries, aiding in the assessment of suitability for applications such as concrete aggregate, rock fill, or large riprap.

III. The RQD is commonly employed as an early warning indicator for low-quality rock zones that require closer examination or additional investigative work, such as further drilling or other techniques.

IV. The RQD forms a fundamental component of various rock mass classification systems used in engineering purposes.

V. Although, the RQD is valuable, it alone does not provide a comprehensive description of rock mass quality. It does not account for factors like joint orientation, tightness, continuity, and presence of gouge material. To obtain a more accurate assessment, the RQD should be used in conjunction with other geological and geotechnical information.

VI. The RQD is sensitive to the orientation of joint sets relative to the core's orientation. If a joint set runs parallel to the core axis, it will not intersect the core unless the drill hole coincides with the joint's path. However, if a joint set is perpendicular to the core axis, it will intersect the core at intervals equal to the joint spacing. For intermediate orientations, the frequency of joint intersections with the core follows a cosine function based on the angle between the joints and the core axis.

VII. Core sizes ranging from BQ to PQ, with core diameters of 36.5 mm (1.44 in.) and 85 mm (3.35 in.), respectively, are generally acceptable for measuring the RQD, provided proper drilling techniques are employed to minimize core breakage or inadequate recovery, or both.

The RQD is also applicable to larger core diameters, provided that the core diameter is clearly stated. RQD values calculated from cores smaller than 36.5 mm may not accurately represent the true quality of the rock mass.

1.7 Literature Review

1. Jianping Li and Ernesto Villaescusa (2005) have established new relationships between critical strain and modulus, as well as between critical strain and compressive strength, for both intact rock and rock masses.

2. G. Tsiambaos, George Tsiambaos, and Harry Saroglou (2009) have proposed original correlations of intact rock properties to indirectly determine the uniaxial compressive strength and modulus of elasticity.

3. Lianyang Zhang (2015) has examined methods for determining the Rock Quality Designation (RQD) and evaluated empirical methods based on RQD for estimating the deformation modulus and unconfined compressive strength of rock masses.

4. Bashar Tarawneh (2016) has assessed the use of Artificial Neural Networks (ANNs) to predict the N60-value using Cone Penetration Test (CPT) data.

5. Ravi Sundaram (2017) has studied geotechnical issues in challenging or unconventional ground conditions, focusing on developing engineering solutions to overcome these problems.

6. Aria Mardalizad and Andrea Manes (2017) have assessed the mechanical response of Pietra sandstone, a rock of intermediate strength, under unconfined compressive loading conditions using both numerical and experimental methods.

7. Bo Wu and Wei Huang (2020) have conducted uniaxial compression tests on a composite stratum where brittle tensile failure occurs, observing that the strength falls between that of soft rock and hard rock.

8. Abiodun Ismail Lawal and Sangki Kwon (2020) have highlighted the challenges associated with limited data and knowledge in rock mechanics and geotechnical problems, emphasizing the need for site-specific analysis.

9. Zhenjiang Liu, Chunsheng Zhang, Chuanqing Zhang, Huabin Wang, Hui Zhou, and Bo Zhou (2021) have presented an SRM (Synthetic Rock Mass) model based on a combination of Discrete Fracture Network (DFN) and Finite-Discrete Element Method (FDEM) to investigate the influence of heterogeneity in the amygdaloidal basalt's structure and sample size on its equivalent mechanical characteristics.

10. Xuefan Wang, Peng Peng, Zhigang Shan, and Zhongqi Yue (2021) have utilized real-time series data from two adjacent drillholes for their analysis, making use of digital factual data.

1.5 Methodology

1. Visit to residential building for collection of information
2. Study existing methods: Core Logging: RQD can be determined by examining drill core samples obtained from exploratory drilling. The core is inspected for the length of intact pieces of rock greater than a specified threshold size (e.g., 10 cm). The ratio of the total length of intact rock to the total length of the core is used to calculate RQD.
3. Rock Mass Classification Systems: Some rock mass classification systems, such as the Rock Mass Rating (RMR) system or the Q-system, incorporate RQD as one of the parameters for assessing the overall quality and behavior of the rock mass.
4. Testing These tests include the following parameters: specific gravity, dry density, bulk density, water absorption, porosity, unconfined compression test, point load index, modulus of elasticity, and Poisson's ratio

1.6 Conclusion

Based on the extensive literature review conducted, we have successfully completed several important milestones in this project. These include the selection of the site area, which was followed by an intriguing observation of the core extraction process. Additionally, we have acquired a comprehensive understanding of the rock quality designation process. These achievements have laid a solid foundation for the subsequent phases of the project.

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