USE OF MOUNTAIN ROCK (SCLERACTINA) IN THE MOUNTAINOUS PAPUA PROVINCE AS A ROAD PAVEMENT MATERIAL.

Abstract:

Mountainous Papua Province has abundant potential for mountain rock (*Scleractinia*) and has the potential to be used as a coating material for road pavement foundations. However, its use is still limited because information is not available on the physical characteristics and carrying capacity of materials according to the 2025 General Specification of Highways. This study aims to analyze the physical characteristics of mountain rocks from five quarries, namely Pugima, Wollo, IlluguaKobakma, Dombomi, and Napua, and determine the value of the California Bearing Ratio (CBR) of the immersion as the basis for assessing the material feasibility for the road foundation layer. The research was carried out through sampling at each quarry and laboratory testing which included gradation analysis, Los Angeles abrasion, Standard Proctor, and CBR immersion according to the Indonesian National Standard (SNI). The results showed that materials from the Pugima, Wollo, IlluguaKobakma, and Napua Quarries generally met the requirements of physical characteristics, while the materials from the Dombomi Quarry had relatively high abrasion values. The highest immersion CBR value was obtained at Quarry IlluguaKobakma at 85.90%, followed by Quarry Wollo at 66.07% and Quarry Pugima at 63.62%. In general, mountain rocks (*Scleractinia*) from most of the research sites have the potential to be used as aggregate foundation layer materials in road construction according to the 2025 Highway General Specifications.

Key words:-
Scleractinia, Mountain rocks, Aggregate foundation layers, CBR immersion

INTRODUCTION

The Mountainous Papua Province has abundant natural resource potential, one of which is mountain rock (*Scleractinia*) which has the potential to be used as a construction material, especially for road pavement foundation layers. The use of local materials is one of the alternatives in supporting sustainable infrastructure development because it is able to reduce dependence on materials from outside the region, reduce transportation costs, and increase the use of local resources. In addition to having economic value, the use of local materials also supports the concept of sustainable development through the reduction of environmental impact due to the exploitation and distribution of construction materials.

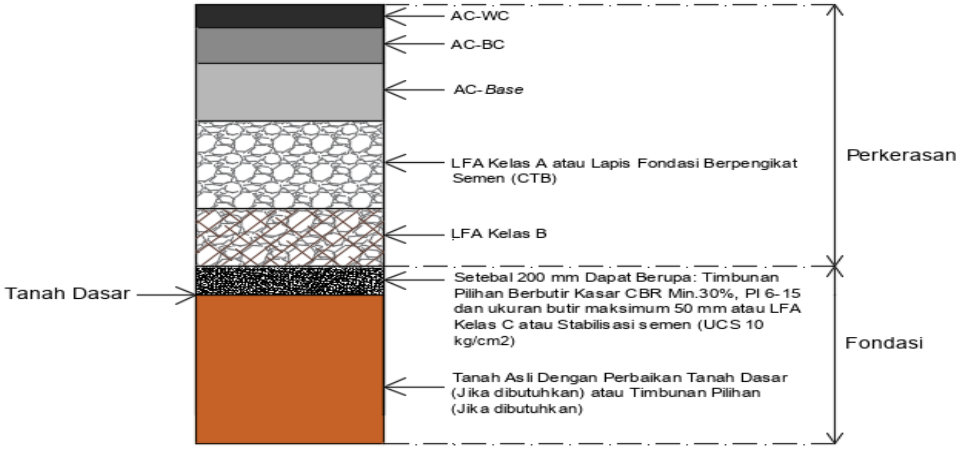
Mountain rock has promising physical and mechanical characteristics as a road pavement material. Several studies show that corals have high compressive strength, resistance to extreme weather conditions, and are able to withstand traffic loads adequately. These characteristics make mountain rock as one of the alternative materials that have the potential to meet the technical requirements of road foundation layers, especially in mountainous areas with limited access to construction materials.

Road construction in Mountainous Papua is still dominated by the use of river stones and sand as the main materials. The continuous use of these materials has increased mining activities in watersheds that have an impact on environmental damage. One of the impacts that occurred was the siltation of the Baliem River and the Uwe River which is suspected to increase the risk of flooding in Wamena City. The flood event in March 2025 that caused thousands of people to be affected and infrastructure damage shows the importance of efforts to find alternative materials that are more environmentally friendly and utilize the potential of local resources.

Several previous studies have examined the use of various types of rocks as road construction materials, but most of them still focus on conventional aggregates or materials from other regions. Research on rocks

THEORY

a. Lapis Pondasi Aggregate



Gambar 2.2

Bending Pavement Structure on Natural Ground Surface (Road Pavement Manual 2024)

The aggregate foundation layer (*base course*) is one of the main layers in the road pavement structure which is located between the surface *course* and the subgrade soil. This layer serves to distribute the traffic load to the layer below it so that the voltage received by the ground ground can be reduced. In addition, the aggregate foundation layer also functions to improve the stability of road construction, provide adequate carrying capacity, facilitate drainage, and maintain a longer pavement service life. Therefore, the quality of foundation layer materials greatly determines the overall performance of road pavement.

Based on the 2025 General Specification of Highways, the aggregate foundation layer is divided into several classes, namely Class A, Class B, and Class S Aggregates. Each class has different gradation requirements, abrasion values, plasticity, specific gravity, water absorption, and California Bearing Ratio (CBR) values according to the road construction function. The material used as the foundation layer must meet all these technical requirements in order to be able to provide stability and resistance to traffic loads and environmental influences.

b. Local Materials as Road Pavement Materials

Local materials are materials that are available around the construction site and can be used as construction materials without requiring a long distribution process. The use of local materials provides various benefits, including reducing transportation costs, accelerating the implementation of work, increasing development efficiency, and supporting the empowerment of regional resources. In addition, the use of local materials is also in line with the concept of sustainable development because it is able to reduce energy consumption and emissions generated from the material transportation process.

Nonetheless, the use of local materials must be supported by laboratory test results to ensure that their physical and mechanical characteristics meet the requirements set out in national standards. Therefore, before being used as a road foundation layer, local materials need to be tested through gradation testing, specific gravity, water absorption, abrasion, plasticity, compaction, and CBR values so that their feasibility can be technically accounted for.

c. Mountain Rock (*Scleractinia*)

Mountain rocks (*Scleractinia*) are carbonate rocks formed from geological processes over a very long period of time through the removal of marine sediments due to tectonic activity. After undergoing the lifting process, the rocks undergo weathering and karstification processes so that they form a limestone mountain landscape. In the mountainous Papua region, mountain rocks are often found in hilly areas and have been used by the community as a storage material and simple construction.

Physically, mountain rocks have a white to gray color with a relatively porous structure and a lower specific gravity compared to volcanic rocks. This material has a higher water absorption ability so it requires laboratory testing before being used as a road construction material. On the other hand, the abundant existence of mountain rocks makes it have great potential as a local aggregate alternative if it meets the technical requirements according to the General Specifications of the Highway.

In this study, mountain rocks were taken from five quarry locations, namely Pugima Quarry, Wollo Quarry, Napua Quarry (Jayawijaya Regency), Dombomi Quarry (Yalimo Regency), and IlluguaKobakma Quarry (Central Mamberamo Regency). The five locations were chosen to determine the variety of material characteristics and their potential use as aggregate foundation layers.

d. Aggregate Physical Characteristics

The aggregate physical characteristics are the main parameters in determining the quality of materials as road pavement materials. These characteristics include grain gradation, specific gravity, water absorption, Los Angeles abrasion value, liquid limit, plastic limit, plasticity index, and maximum density of Proctor test results. Each parameter provides information about the strength, stability, and durability of the aggregate against loads and environmental influences.

The gradation of aggregates affects the compaction ability and stability of the foundation layer. The specific gravity and water absorption describe the density and porosity of the material, while the abrasion value indicates the aggregate's resistance to frictional wear. Meanwhile, liquid limit, plastic limit, and plasticity index testing were used to determine the plastic properties of the fine materials contained in the aggregate. All of these parameters are the basis for determining whether the material meets the requirements as an aggregate foundation layer according to the 2025 General Specification of Highways.

e. California Bearing Ratio (CBR)

The California Bearing Ratio (CBR) is one of the most widely used parameters in road pavement planning to assess the carrying capacity of soil and aggregates. The CBR value indicates the ability of a material to withstand penetration loads compared to standard materials under certain conditions. The higher the CBR value, the greater the material's ability to withstand traffic loads, so that the better the quality as a road foundation layer.

In this study, soaked CBR (Soaked CBR) was used because the test was able to describe the condition of the material after experiencing water immersion that resembled field conditions in the rainy season. Based on the 2025 General Specification of Highways, the minimum CBR value for aggregate foundation layers must meet a predetermined limit in order for the material to be used as part of the road pavement structure. Therefore, the results of the CBR test are the main parameters in determining the feasibility of mountain rocks (*Scleractinia*) from five quarry locations as aggregate foundation layer materials. Here are the stone samples:

Gambar 2.5 Batu Karang GunungPugima

Gambar 2.6 Batu Karang GunungIlugua

Gambar 2.7 Batu Karang Gunung Wollo

Gambar 2.8 Batu Karang GunungNapua

Gambar 2.9 Batu Karang GunungDombomi

METHOD

a. Research Location and Time

The research was carried out in Mountainous Papua Province with material collection locations at five quarries, namely Pugima Quarry, Wollo Quarry, and Napua Quarry in Jayawijaya Regency, Dombomi Quarry in Yalimo Regency, and IlluguaKobakma Quarry in Central Mamberamo Regency. The five locations were chosen because they have a considerable potential for mountain rocks (*Scleractinia*) and represent geological characteristics in the mountainous Papua region. Sampling will be carried out in December 2025, while all laboratory tests will be carried out after the sampling process is completed.

b. Research Materials

The main material of the research is mountain rock (*Scleractinia*) which was taken directly from five quarry locations. Samples were taken from each location weighing about 250 kg to represent the condition of the material in the field. In addition to primary data from laboratory test results, this study also uses secondary data in the form of the 2025 General Specification of Highways, Indonesian National Standards (SNI), as well as the results of previous research related to the use of coral as road construction materials.

c. Data Collection

Data collection is carried out through two stages, namely primary data collection and secondary data. Primary data was obtained through field surveys and mountain rock sampling at five quarries, then continued with laboratory testing. The tests carried out included gradation analysis, specific gravity and water absorption, Los Angeles wear, melt limit, plastic limit, plasticity index, Standard Proctor, Modified Proctor, and California Bearing Ratio (CBR) immersion (*Soaked CBR*). All tests are carried out referring to the applicable Indonesian National Standards (SNI).

Secondary data were obtained from literature, technical standards, and previous research results as a comparison with research results.

d. Data Analysis

Data analysis was carried out descriptively and comparatively. The results of the physical characteristics test of each material are compared with the technical requirements listed in the 2025 General Specification of Highways for aggregate foundation layers. Furthermore, an analysis of the soaking CBR value was carried out to determine the feasibility of mountain rock as a road foundation layering material. Data processing is carried out using Microsoft Excel so that average values, graphs, and tables of test results are obtained, which are then interpreted based on applicable standards.

e. Research Stages

The research stage consists of five main steps, namely:

1. Research preparation, including literature study, problem identification, and determination of research location.
2. Sampling is the extraction of mountain rock material (*Scleractinia*) from five quarries in the Mountainous Papua Province.
3. Laboratory testing, including testing of aggregate physical characteristics and mechanical testing in the form of Standard Proctor, Modified Proctor, and CBR immersion according to SNI standards.
4. Data analysis, which is to compare the test results with the requirements of the 2025 General Specification of Highways to assess the feasibility of materials as aggregate foundation layers.
5. The conclusion was drawn from the physical characteristics of mountain rocks and determined their feasibility as a road foundation layer material based on laboratory analysis results.

RESULT AND DISCUSS

a. Physical Characteristics of Mountain Rock (*Scleractinia*)

The physical characteristics of mountain rocks from five quarry sites were analyzed through gradation, Los Angeles abrasion, and density testing (Standard Proctor). The test was carried out to evaluate the suitability of the material to the requirements of the 2025 General Specification of Bina Marga as an aggregate foundation layer material. The test results show that each quarry has different characteristics, especially in the grain size distribution, abrasion resistance, and maximum density.

The results of the gradation analysis showed that materials from the Pugima, Wollo, Illugua, Dombomi, and Napua Quarries had a percentage that passed the No.4 filter in the range of 35.8–64.15%, while the percentage of the No.200 filter passed was around 1.0–5.9%. The difference in gradation shows that there is a variation in the size of the grains in each quarry, but in general the material still has the potential to be used as an aggregate of the foundation layer after the mixed gradation arrangement is carried out.

Los Angeles abrasion testing showed that materials from the Pugima Quarry (24.49%), Wollo (24.49%), Illugua (30.46%), and Napua (28.03%) met the wear resistance requirements for aggregate foundation layers. In contrast, the material from the Dombomi Quarry has an abrasion value of 59.05%, so it does not meet the requirements because it has low wear resistance. These results show that most of the mountain rocks have good mechanical resistance, except for materials from the Dombomi Quarry which require treatment or mixing with other materials before use.

The results of the Standard Proctor test showed that the maximum dry density value (maximum γd) was in the range of 1.99–2.19 g/cm^3, while the optimum moisture content was in the range of 5.5–10%. This value shows that the

material has a good enough compaction ability so that it can form a stable foundation layer when compacted at optimal moisture content. Thus, based on their physical characteristics, the four quarries namely Pugima, Wollo, Illugua, and Napua have good potential as a source of foundation layer aggregates, while the Dombomi Quarry requires further evaluation because its abrasion value is relatively high.

b. CBR Value Mixed Soaking Mountain Rock Material

The California Bearing Ratio (CBR) test of immersion was carried out to determine the carrying capacity of a mixture of mountain rock materials as a road foundation layer. The CBR value is one of the main parameters in determining material feasibility because it shows the aggregate ability to withstand loads after experiencing water saturated conditions.

Unsoaked CBR and CBR soaked Agrergat Test Results at 5 Quarry

Quarry	Tumpukan/Lapis	kadar air (%)	CBR unsoaked (%)	CBR soaked (%)	Jenis Perkerasan
Pugima	10	7.48	23.06	13.836	TimbunanPilihan
Pugima	30	7.32	62.55	37.53	TimbunanPilihan
Pugima	65	7.49	63.615	38.169	TimbunanPilihan
Pugima	Gabungan	6.2	49.74	29.844	TimbunanPilihan
Wolo	10	5.32	18.48	11.088	TimbunanPilihan
Wolo	30	5.41	32.72	19.632	TimbunanPilihan
Wolo	65	5.19	66.065	39.639	TimbunanPilihan
Wolo	Gabungan	6.2	39.09	23.454	TimbunanPilihan
Ilugua	10	9.36	21.665	12.999	TimbunanPilihan
Ilugua	30	8.81	39.55	23.73	TimbunanPilihan
Ilugua	65	8.79	85.9	51.54	Lapis PondasiKelas S
Ilugua	Gabungan	6.2	49.04	29.424	TimbunanPilihan
Dombomi	10	5.38	38.61	23.166	TimbunanPilihan
Dombomi	30	5.1	59.5	35.7	TimbunanPilihan
Dombomi	65	5.46	81.065	48.639	TimbunanPilihan
Dombomi	Gabungan	6.2	59.72	35.832	TimbunanPilihan
Napua	10	8.35	24.28	14.568	TimbunanPilihan
Napua	30	7.49	76.445	45.867	TimbunanPilihan
Napua	65	27.53	20.95	12.57	TimbunanPilihan
Napua	Gabungan	6.2	40.56	24.336	TimbunanPilihan

Tabel 4.31 Hasil Uji CBR Soaced dan CBR Unsoaced

The results of the CBR Soaced and CBR Unsoaced tests from 5 *Quarries* found the lowest CBR Soaced from 11.088% to 48.639% with 5.32% - 5.46% moisture content in the Preferred Backfill Pavement Type. CBR Unsoaced 51.54% with 8.79% moisture content is in the type of foundation layer pavement class S. The test results showed that the CBR value increased as the compaction energy increased. In all materials, the CBR value of compaction of 65 impacts is higher than that of compaction of 10 and 30 impacts. This shows that the density level has an influence on the increase in the carrying capacity of the material.

Based on the test results, the material from the Illugua Quarry produced the highest CBR value of **85.90%,** followed by the Wollo Quarry of 66.07%, the Pugima Quarry of 63.62%, while the Dombomi Quarry and the Napua Quarry had relatively lower values. These results show that the material mixture from the Illugua, Wollo, and Pugima Quarry has a better load-bearing ability than other quarries.

Overall, the results showed that mountain rock (*Scleractinia*) from most quarries had physical characteristics and CBR values that met the requirements of the 2025 Bina Marga General Specification for use as aggregate foundation coating materials. Materials from the Pugima, Wollo, Illugua, and Napua Quarries deserve to be considered as local aggregate sources, while materials from the Dombomi Quarry require quality improvement or mixing with other materials before being applied to road construction. These findings show that the use of mountain rocks as a local material has the potential to reduce dependence on aggregates from outside the region and support the development of more efficient and sustainable road infrastructure in the Mountainous Papua Province.

CONCLUTION

1. The physical characteristics of the local materials of the 5 *Quarries* are
    a. *Pugima Quarry* with Filter Analysis (gradation) Sieve no.4 is 59.5% and Sieve 200 is 3.8%, LPA Abrasion class A value is 24.75%, density value ɣd max = 2.19 gr/cc and *Optimum Moisture Content* is 5.6%.
    b. *Wolo Quarry* with Filter Analysis (gradation) Sieve no.4 is 59.4% and Sieve 200 is 3.81%, LPA Abrasion class A value is 24.23, Density ɣd max = 1.13 gr/cc and *Optimum Moisture Content* is 5.5%.
    c. *Ilugua Quarry* with Filter Analysis (gradation) Sieve no.4 is 41.9% and Sieve 200 is 4.2%, LPA Abrasion class A value is 30.46%, Density ɣd max = 2.09 gr/cc and Optimum Moisture *Content* is 10%.
    d. *Dombomi Quarry* with Filter Analysis (gradation) Sieve no.4 is 55.5 % and Sieve 200 is 5.9 %, Abrasion does not pass the value of 59.05%, Densityɣd max = 1.99 gr/cc and *Optimum Moisture Content* is 5.5%.
    e. *Napua Quarry* with Filter Analysis (gradation) Sieve no.4 is 64.15% and Sieve 200 is 1.0%, LPA abrasion class A value is 28.52, density ɣdmax = 2.15 gr/cc and *Optimum Moisture Content* is 7.2%.
2. After the CBR Combined *Soaked* experiment was carried out, the value of *the Pugima Quarry* (Jayawijaya Regency) was the Preferred Deposit, the Wollo *Quarry* (Jayawijaya Regency) was the Preferred Deposit, *the IlluguaKobakma Quarry (Central Mamberamo Regency) was the Class S Foundation Layer,* the Dombomi*Quarry* (Yalimo Regency) was the Preferred Deposit, *the Quarry* Napua (Jayawijaya Regency) is the Preferred Stockpile.

REFERENCE

Sari, D., et al. (2020). "KarakteristikFisik dan Mekanik Batu Karang Gunungsebagai Material Konstruksi." Jurnal Teknik Sipil, 12(2), 45-56.

Junaedi (2022) “Perbandingan Daya Dukung CBR Kondisi Soaked dan Unsoaked AgregatKelas B Berdasarkanvariasigradasilapangan” JurnalPoliteknikBengkalis, 124-14

Zainuddin, M., et al. (2021). "KarakteristikFisik dan Mekanik Batu Karang Scleractinia sebagai Material Perkerasan Jalan." *Jurnal Teknik Sipil*, 12(3), 45-58.

Prasetyo, A., & Supriyadi, B. (2020). "PengelolaanSumber Daya Alam BerbasisLingkungan di Kawasan Terumbu Karang." *JurnalLingkungan*, 15(2), 75-89.

Sari, R., et al. (2022). "Dampak Ekonomi Pemanfaatan Batu Karang dalamProyekInfrastruktur di Papua." *Jurnal Ekonomi dan Pembangunan*, 10(1), 22-35.

LyresicaNurmalasariSirait (2023). “Analis Karakteristik Material LokalKinangJingkion”. Tesis Teknik SipilUncen.

SE Dirjen Bina Marga, Spesifikasi Umum 2025: untukKonstruksiPekerjaan Jalan dan Jembatan, DirektoratJemderal Bina Marga-Kementerian PUPR, Jakarta

SNI 1969:2008 cara uji beratjenis (Specipic Gravity) agregatkasar, Badan Standarisasi Nasional, Jakarta

SNI 1970:2008 cara uji beratjenis (Specipic Gravity) agregathalus Badan Standarisasi Nasional, Jakarta

SNI 1943:2008 cara uji Kepadatan Berat (Modifeld Proctor Test) Untuk Tanah, Badan Standarisasi Nasional, Jakarta

SNI 3423:2008 cara uji AanalisisUkuranButir (Gradasi) Untuk Tanah, Badan Standarisasi Nasional, Jakarta

SNI 1744:2012 Metode uji CBR (California Bearing Racio) Laboratoium, Badan Standarisasi Nasional, Jakarta