

The Republic of the Union of Myanmar
Ministry of Natural Resources and Environmental Conservation
Forest Department



**Preliminary Exploration of Raw Materials for Urban
Construction, Naypyitaw Union Territory, Myanmar**

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Abstract

In recent years, Naypyitaw Union Territory has been developing rapidly and the population has also increased. As Naypyitaw Union Territory has been developing, the Department of Geological Survey and Mineral Exploration has performed preliminary urban geological mapping of regions around Naypyitaw: to mitigate geological hazards; to explore the raw materials for urban construction in Naypyitaw region; to find out the extent of hazardous solvent in the top layer soils; to examine the depth and quality of underground water; to draw the map showing different types of rock; and to draw the map for physically distinctive geosites. In this paper, the information on exploration of available raw geological construction materials for urban constructions in the regions around Naypyitaw is presented. Seven types of potential raw materials for construction have been detected and around 2,790,000 metric tons of gravel beds, 587,000 metric tons of sands, 840,000 metric tons of slaty mudstone, 7,450,000 metric tons of quartzite, 16.27 million metric tons of marbles, 60,000 metric tons of gneiss, and 45,000 metric tons of granite have been calculated.

Keywords: Gneiss, Granite, Gravel beds, Marble, Quartzite, Sand, Slaty Mudstone

ပြည်ထောင်စုနယ်မြေ၊ နေပြည်တော်ဝန်းကျင်ဒေသ မြို့ပြအကျိုးပြု ဘူမိဗေဒမြေပုံရေးဆွဲရေး
လုပ်ငန်း၏ ပဏာမအဆင့်တည်ဆောက်ရေးလုပ်ငန်းသုံး ကုန်ကြမ်းပစ္စည်းများ ရှာဖွေရေး

ကျော်ကျော်ဦး၊ ဆက်ဖ၊ သက်တင်ညွန့်၊ မြင့်စိုး၊ ဇော်လင်းအောင်၊ အောင်ကျော်မိုး၊

အောင်သန်း၊ အောင်မင်း၊ ကျော်ဇေယျာ

ဘူမိဗေဒလေ့လာရေးနှင့် ဓာတ်သတ္တုရှာဖွေရေးဦးစီးဌာန

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စာတမ်းအကျဉ်း

မကြာသေးမီနှစ်များအတွင်း ပြည်ထောင်စုနယ်မြေ နေပြည်တော်ဒေသသည် အလျှင်
အမြန် ဖွံ့ဖြိုးတိုးတက်လာပြီး၊ လူဦးရေလည်းများပြားလာခဲ့ပါသည်။ ဘူမိဗေဒလေ့လာရေးနှင့်
ဓာတ်သတ္တုရှာဖွေရေးဦးစီးဌာနသည် ပြည်ထောင်စုနယ်မြေ နေပြည်တော်ဒေသအား ဖွံ့ဖြိုး
တိုးတက်လာသည် နှင့်အမျှ ဘူမိဗေဒဆိုင်ရာဘေးအန္တရာယ်များ လျော့နည်းသက်သာစေရန်၊
နေပြည်တော်ဒေသ မြို့ပြတည်ဆောက်ရေးလုပ်ငန်းများတွင် လိုအပ်သည့် တည်ဆောက်ရေး
လုပ်ငန်းသုံး ကုန်ကြမ်းပစ္စည်းများရှာဖွေရန်၊ မြေမျက်နှာပြင်အပေါ်ပိုင်း မြေဆီလွှာများ အတွင်း
တွင် လူတို့အတွက် အဆိပ်သင့်အန္တရာယ်ရှိစေနိုင်သော ဓာတ်ပစ္စည်းများ ပျော်ဝင်နေခြင်း
ပမာဏအရေအတွက် အနည်းအများကို သိရှိစေနိုင်ရန်၊ မြေအောက်ရေ တည်ရှိမှုအနက်နှင့်
အရည်အသွေးကို သိရှိစေရန်၊ ကျောက်မျက်နှာပြင်အစားပြ မြေပုံရေးဆွဲရန်နှင့် ရုပ်သွင်ထူးခြားသော
ဘူမိနယ်မြေများပြ မြေပုံရေးဆွဲရန် ရည်ရွယ်၍ ပဏာမအဆင့် နေပြည်တော်ဝန်းကျင်ဒေသ
မြို့ပြဘူမိဗေဒမြေပုံ ရေးဆွဲရေးလုပ်ငန်းအား ဆောင်ရွက်ခဲ့ပါသည်။ ယခုစာတမ်းတွင် နေပြည်တော်
ဝန်းကျင်ဒေသတွင် တွေ့ရှိနိုင်သည့် တည်ဆောက်ရေးလုပ်ငန်းသုံး ကုန်ကြမ်းပစ္စည်းများ
ရှာဖွေရေးလုပ်ငန်းအကြောင်း တင်ပြထားပါသည်။ နေပြည်တော်ဝန်းကျင်ဒေသတွင် အလား
အလာရှိသော ဘူမိဗေဒဆိုင်ရာ တည်ဆောက်ရေး လုပ်ငန်းသုံး ကုန်ကြမ်းပစ္စည်း (၇) မျိုး ရှာဖွေ
တွေ့ရှိခဲ့ပြီး၊ (သ-၄) အဆင့် တန်ချိန်ပမာဏအနေဖြင့် စရစ်ဖြုန်းကျောက် ၂,၇၉၀,၀၀၀ မတ်ထရစ်
တန်၊ သဲ ၅၈၇,၀၀၀ မတ်ထရစ်တန်၊ သင်ပုန်းကျောက်ဆန် ရွှံ့ကျောက် ၈၄၀,၀၀၀ မတ်ထရစ်တန်၊
ကွာဇိုက်ကျောက် ၇,၄၅၀,၀၀၀ မတ်ထရစ်တန်၊ စကျင်ကျောက် ၁၆.၂၇ သန်း မတ်ထရစ်တန်၊
လိပ်သဲကျောက် ၆၀,၀၀၀ မတ်ထရစ်တန်နှင့် နှမ်းဖတ်ကျောက် ၄၅,၀၀၀ မတ်ထရစ်တန်ခန့်
ရှာဖွေဖော်ထုတ် ပေးနိုင်ခဲ့ပါသည်။

သော့ချက်စကားလုံးများ။ ကွာဇိုက်ကျောက်၊ စကျင်ကျောက်၊ စရစ်ဖြုန်းကျောက်၊ သဲ၊

နှမ်းဖတ်ကျောက်၊ လိပ်သဲကျောက်၊ သင်ပုန်းဆန်ရွှံ့ကျောက်

Preliminary Exploration of Raw Materials for Urban Construction, Naypyitaw Union Territory, Myanmar

1. Introduction

The Naypyitaw Union Territory is an administrative division in central Myanmar. Naypyitaw is the capital and third-largest city of Myanmar. Naypyidaw Union Territory consists of (2) districts, subdivided into (8) townships (Figure 1). As Naypyitaw region has been developing, the Department of Geological Survey and Mineral Exploration has carried out the tasks of landslide hazard zonation mapping and earthquake hazard zonation mapping to reduce geological hazards indicative mapping for the types of rock and physically distinctive geosites regions in order to find out the extent of hazardous solvent in the top layer soils and to know the existence and quality of underground water; and preliminary urban geological mapping in order to explore raw materials those are needed for urban constructions in Naypyitaw region. Likewise, raw materials such as rock, sand and soil play vital roles in urban construction and development. Raw materials are which naturally existing materials such as soil, sand, rock, gravel, crushed rocks, and big stones which are used to prevent erosion, reinforce the wall, and decoration. Therefore, the Department of Geological Survey and Mineral Exploration under the Ministry of Natural Resources and Environmental Conservation has performed exploration of raw materials under urban geological mapping with the supervision of the Directors and Deputy Directors and monitored by Deputy Director General and instructed by the Director General.

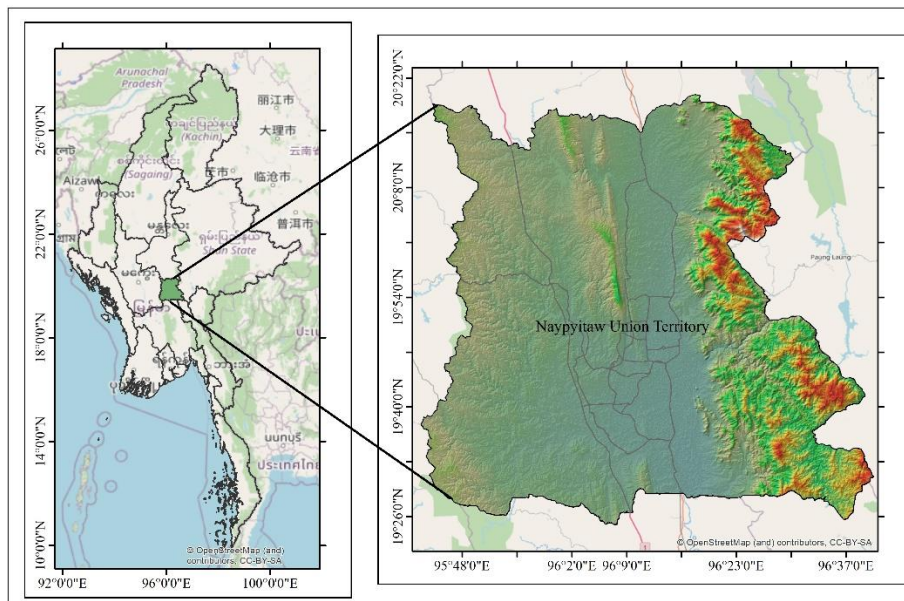


Figure 1. Location Map of the Naypyitaw

2. Objectives

As the raw materials for the urban development plays a vital role in implementing the exploration of natural resources. The objectives of the study is to report the work progress, work done, findings, reviews and benefits of exploration of raw materials around Naypyitaw region for dams, express ways, airports, housing developments and other construction projects.

3. Materials and Methods

3.1. Study area

Naypyidaw is located between the Bago Yoma and Shan Yoma mountain ranges. Centrally located, it is 376 km from Yangon and 274 km from Mandalay, being easily

accessible from all parts of the Union. The study area, Naypyitaw is situated within 19° 23' and 20° 20' N latitude and between 95° 43' and 96° 40' E longitude (Figure. 1). The total area of Naypyitaw is approximately 7,054.37 km². It can be easily reached by car from Yangon and Mandalay to Taunggyi and the research area can be easily reached by cars and motorbikes using this Highway Road for the whole year.

3.2. Geomorphology and Geology

The study area is the western mountain foot of Shan Plateau which is situated among the lower plains of central Myanmar. The geographical and geological feature of the site can be divided into (3) categories in general. Lower land and paddy fields alone can be found in the western parts of the site and the estimated height of the land is 130 meters above the sea level. In the central parts of the site, Phoe Saung terrain which is 600 meters above the sea level and other moderate hills, branches and slopes which are 250 meters above the sea level can be found. They are mainly comprised of sandstone and gravel bed and the range trend from North to South with gradual descending in the South. Eastern parts of the site are mountainous region consisting of steep slopes, range and branches. They are 230 to 1200 meters above the sea level and mainly composed of granite and metamorphic rocks (Sein Htun and Aye Myint Zaw, 1980). The drainage system is dendritic pattern and Ngalite Chaung, Sin Thay Creek and Paung Laung River are prominent.

3.3. Method

Field measurement was carried-out from 15.11.2021 to 15.1.2022. In doing field work, geological maps of previously completed works, satellite images, Google Earth images, and UTM 1:50000 scale maps are used to explore current project areas and potential areas of construction materials. In doing field works, the information is collected from local residents, engineers and contractors and measuring of the direction and angle of rock layers, joints, thickness of the rock layers, rock quality designation, uniaxial compressive strength, weathering of rocks and potential site for manufacturing construction materials.

4. Results and Discussion

The study area is included in Central Myanmar Basin and Western Mountain Foot of Shan Plateau. Sands, Alluvium, Gravel bed, and Sandstone which are the member of rock layers in Pegu Group and Irrawaddy Formation can mainly be found in the Western part of the site. As the Eastern Part of the site is a mountainous region, slaty mudstone, quartzite, marble, gneiss and granite can be found.

4.1. Gravel beds

Gravel beds can be found in alternated layers with brownish yellow sand grains. The unit that contains conglomerate is 1.5 m to 3 m thick. Mostly, they are composed of 0.8 cm– 5 cm sized round white gravels and red gravels (Figure 3). Those gravels exist in the base which consists of brownish yellow sand grains (Dr U Thein, 1978). They exist as hills and mountains from NNW to SSE runs from UTM 1996-01 202503 E/ 2202382 N, Gwaygyi Cemetery, Pobbathiri Township to UTM 1996-01 204952E, 2187299 N, Thapyay Taung Monastery at South Gate of Uppatasanti Pagoda, Pobbathiri Township. It has been found that 30% Safety Factor obtained P-4 level 720,000 metric tons at UTM 1996-01 203626E/2197537N (Kyaw Kyaw Oo and Sat Pha, 2022), North of Thirimandaing Road, Pobbathiri Township, 30% Safety Factor obtained P-4 level 600,000 metric tons at UTM 1996-01 202931 E/ 2197031 N, South of Thirimandaing Road, Pobbathiri Township, 30% Safety Factor obtained P-4 level 700,000 metric tons at UTM 1996-01 203241 E/ 2194579 N (Kyaw Kyaw Oo and Sat Pha, 2022), west to Padonma Religious Store (Figure 2), and 30% Safety Factor obtained P-4 level 250,000 metric

tons at UTM 1996-01 203905 E/ 2189676 N (Kyaw Kyaw Oo and Sat Pha, 2022), near Yaypyar village have been utilized for the constructions work. Another potential sites and possible amount for conglomerates for construction materials are 30% Safety factor obtained P-4 level 400,000 metric tons at UTM 1996-01 202503 E/ 2202382 N (Kyaw Kyaw Oo and Sat Pha, 2022), near Gwaygyi Cemetery, Pobbathiri Township, and 30% Safety factor obtained P-4 level 120,000 metric tons at UTM 1996-01 203637 E/ 219151 N (Kyaw Kyaw Oo and Sat Pha, 2022), west of Naypyitaw Regional Military Command, Pobbathiri Township (Map 1). Those materials like 0.8 cm – 5 cm coarse grain gravels, red sandy gravels and gravel bed mixed with brownish yellow sand particles and red-brown sand particles which can be found around Naypyitaw Territory are granular soil. And they can be used in soil filling of empty plot of land or stadium, and in constructing road filled slope and earth road.



Figure 2. Gravel bed Quarry at west to Padonma Religious Store



Figure 3. Photograph showing Gravel bed outcrop

4.2. Sand

Sand is one of the most basic construction materials and is mainly composed of minute quartz and can be made up of small rock particles and various shells depending on the location. The size can be from 0.0625 mm to 2 mm and they can be divided into very small sand sizing from 0.0625 mm to 0.125 mm, small sands sizing from 0.125 mm to 0.25 mm, moderate sand sizing from 0.25 mm to 0.50 mm, and coarse sand sizing from 0.50 mm to 1 mm. The locations and metric tons which have been discovered are 30% Safety factor obtained P-4 level 16,000 metric tons at UTM 1996-01 189383 E/ 2198018 N, Ngalike Chaung, Kywalshin Village, Ottarathiri Township (Figure 6), 30% Safety Factor obtained P-4 level 81,000 metric tons at UTM 1996-06 208837 E/ 2194891 N (Kyaw Kyaw Oo and Sat Pha, 2022), Sin Thay Chaung, Thayet Thamain Village, Pobbathiri Township (Figure 5), 30% Safety Factor obtained P-4 level 24,000 metric tons at UTM 1996-06 214135 E/ 2183536 N, Sin Thay Chaung, Nyaungpingyi Village, Pyinmana Township, 30% Safety Factor obtained P-4 level 175,000 metric tons at UTM 1996-05 217447 E/ 2186064 N, Paunglaung River, Kyihtaung Village, Pobba Thiri Township. Other potential locations and possible quantities are 30% Safety Factor obtained P-4 level 14,000 metric tons at UTM 1996-01 190403 E/ 2196860 N, Ngalike Chaung, Thekyun Village, Ottarathiri Township, 30% Safety Factor obtained P-4 level 152,000 metric tons at UTM 1996-06 217177 E/ 2184114 N, Paunglaung River, Sipin Village, Zayarhithi Township (Figure 4), and 30% Safety Factor obtained P-4 level 125,000 metric tons at UTM 1996-07 215742 E/ 2158036 N (Kyaw Kyaw Oo and Sat Pha, 2022), Sittaung River, Bawdigone Village, Lewe township (Map 2) (Figure 7).



Figure 4. Sand at Paunglaung River

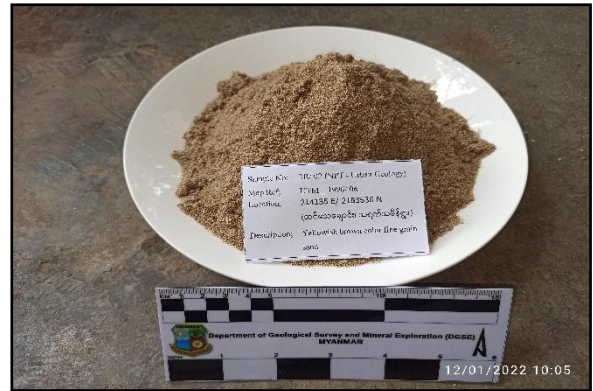


Figure 5. Sand at Sin Thay Chaung

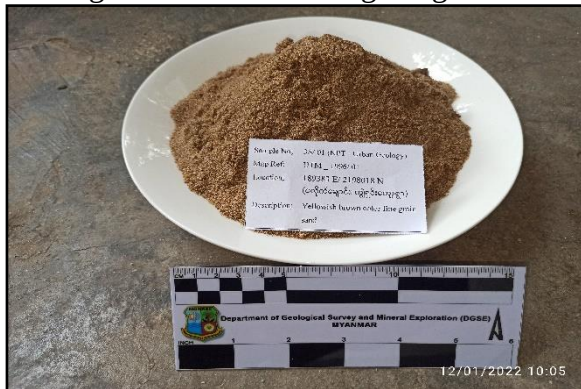
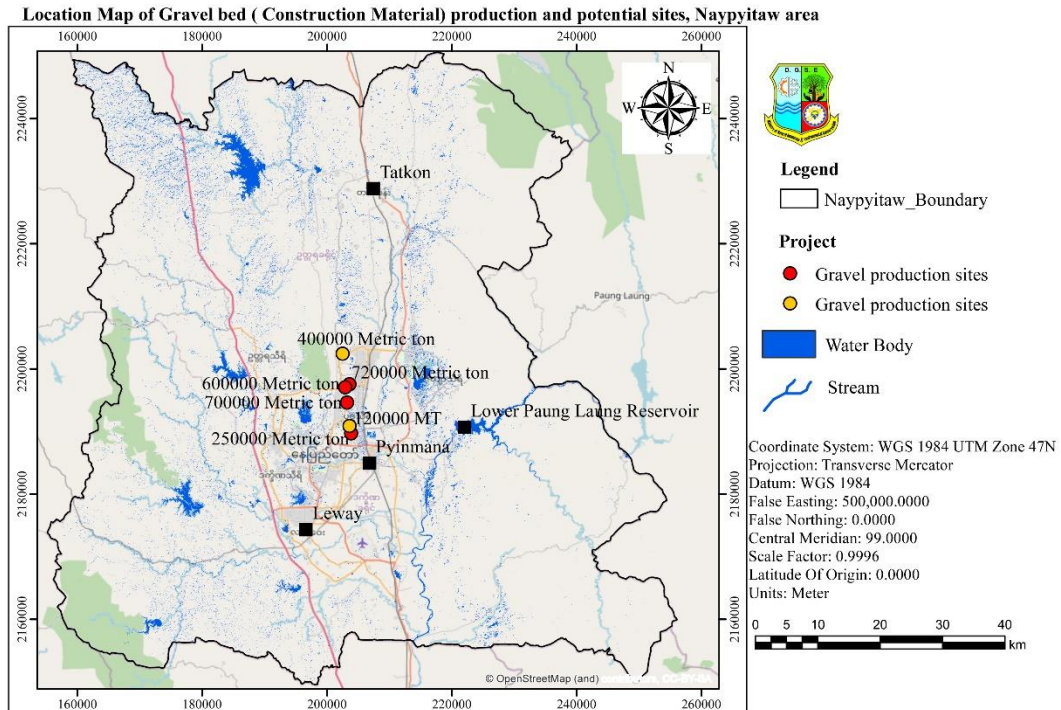


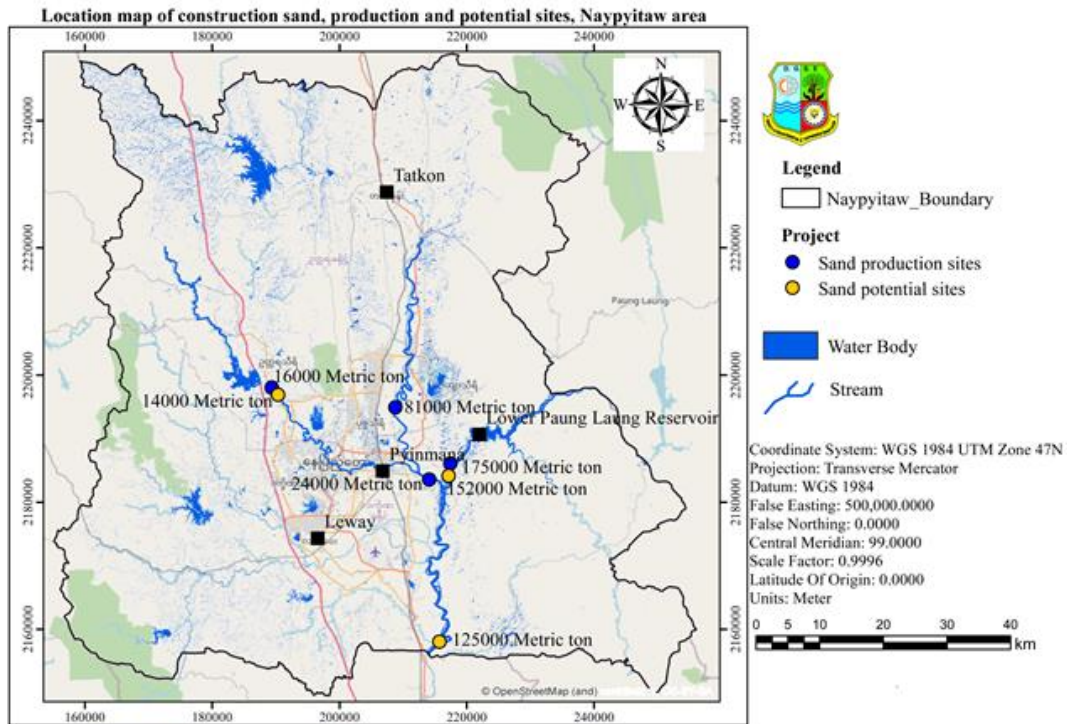
Figure 6. Sand at Ngallike Chaung



Figure 7. Photograph showing the Sand at Naypyitaw area



Map 1. Location map of gravel bed (Construction material), production and potential sites, Naypyitaw area



Map 2. Location map of Sand, production and potential sites, Naypyitaw area

4.3. Slaty mudstone

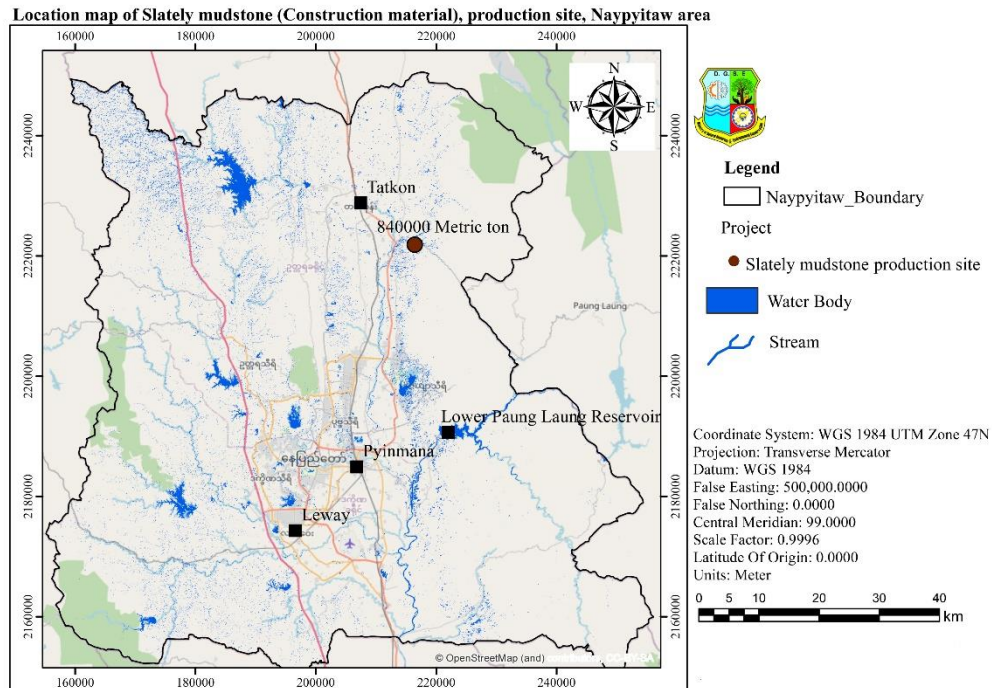
Slaty mudstones are the sedimentary rocks that are made up of minute muddy and granular particles that are smaller than 0.05 millimeter and unable to be seen with naked eyes (Dr U Thein, 1978) (Figure 9). Slaty mudstones can be found at UTM 2096/ 08 216478 E/ 2221816 N, Kinthar Village (Figure 8), Tatkone Township with the direction of 330° and 75° dipping towards southwest direction and highly joint sets. Rock Quality Designation is 40% and Uniaxial Compressive Strength is of moderate. Slaty mudstone excavated from Rock manufacturing plantations around Kinthar Village, Tatkone Township are used as filling rocks in gravel road constructions around Naypyitaw region. 30% Safety Factor obtained P-4 level 840,000 metric tons (Map 3) (Kyaw Kyaw Oo and Sat Pha, 2022) can be excavated for construction works.



Figure 8. Slaty mudstone Quarry, at Kintha village



Figure 9. Slaty mudstone sample, at Kintha village



Map 3. Location map of Slaty mudstone (Construction material) production site, Naypyitaw area

4.4. Quartzite

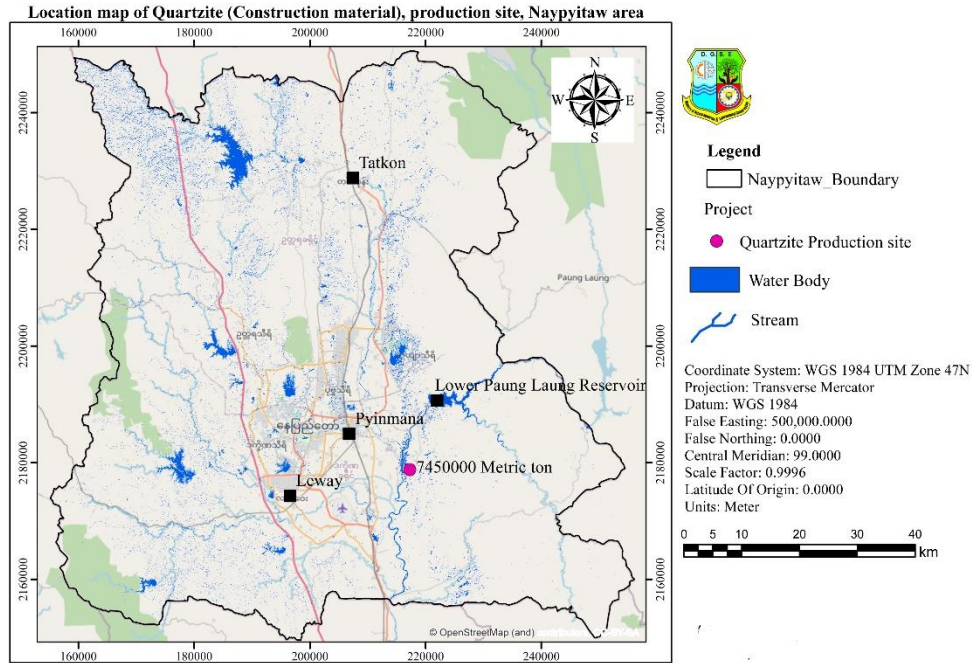
Quartzites are originally sandy rocks and are hard and flake less metamorphic rocks. Although the majority of quartzite rocks are white and gray, orange, green and blue quartzite rocks can sometimes be found (Dr U Thein, 1978) (Figure 11). Brownish yellow quartzite rocks can be found at UTM 1996- 06 217223 E/ 2178826 N, Wetthoe Mountain region (Figure 10) with the direction of 250° at 20° dipping towards Northwest direction with highly Joint Sets and scattered jutties. There are few good protruding parts. Rock quality designation is 40% and uniaxial compressive strength is a little bit hard but easy to be crushed. Brownish yellow quartzite rocks are produced at 2.5 cm x 5 cm, 5 cm x 10 cm, 15 cm x 23 cm size for rock aggregates for road construction. There is approximately 7,450,000 metric tons of 30% Safety factor obtained P-4 level remaining (Map 4) (Kyaw Kyaw Oo and Sat Pha, 2022).



Figure 10. Quartzite Quarry at Wetthoe Mountain region



Figure 11. Photograph showing the Quartzite outcrop



Map 4. Location map of Quartzite (Construction material) production site, Naypyitaw area

4.5. Marble

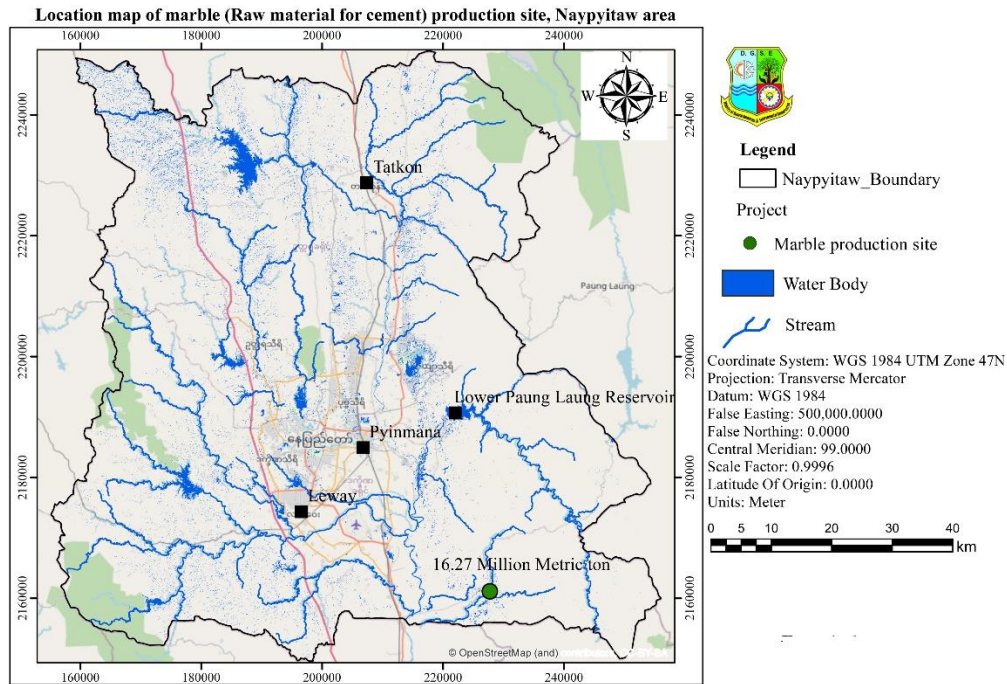
Marbles are mainly metamorphosed from limestone. Marbles are mainly composed of Calcite and can be found as interlocking grains and yet sometimes in flakes (Dr U Thein, 1978). They can be found in Taung Phi Lar region, Lewe Township in the color of white, light grey and grey with medium to thick bedded, medium to coarsed grain and sometimes series of layers. They are crushed at the part closer to the Faults. As those marbles are metamorphosed from limestone, it is found that they can be used as raw materials required for producing cements. Marbles from Taung Phi Lar region, Lewe Township (Figure 12, 13) contains approximately of CaO 53.31 %, MgO 0.73 % and SiO₂ 1.03 % and there is 18.77 million metric tons (Map 5) of P-2 level according to the calculation done by Assistant Geological Officer U Win Htike Oo in June, 2011. Max Myanmar Group is mining them to be used in producing of cements at 2,100 tons per day and total of 2.5 million metric tons have been utilized. Therefore, the remaining can be approximately of 16.7 metric tons (Kyaw Kyaw Oo and Sat Pha, 2022).



Figure 12. Marble Quarry at Taung Phi Lar region, in Naypyitaw area



Figure 13. Marble outcrop at Taung Phi Lar region, in Naypyitaw area



Map 5. Location map of marble (Raw material for cement) production site, Naypyitaw area

4.6 Gneiss

Gneiss is mainly metamorphosed from granite, arkose sandstone, shale, talc and rhyolite rocks. Gneiss mainly contains quartz and feldspar. Other minor containments are mica, hornblende, tourmaline and garnet. Sometimes, it can contain more alkali feldspar than quartz. As Gneiss is hard, they are used as road filling rock (Dr U Thein, 1978) (Figure 15). Augen Gneiss can be found at UTM 1996-06 228016 E/ 2163562 N, Alinyaung quarry, Aungsithar Ward, Taung Phi Lar region, Lewe township (Figure 14) (Map 6), running from South to North with dipping to east. Rock Quality Designation is 60% and Uniaxial compressive strength is of medium hard. It is found that Gneiss is crushed into 2.5 cm x 5 cm, 5 cm x 10 cm, 15 cm x 23 cm sizes for road filling. There are 60,000 metric tons remaining of 30% safety factor obtained P-4 level (Kyaw Kyaw Oo and Sat Pha, 2022).

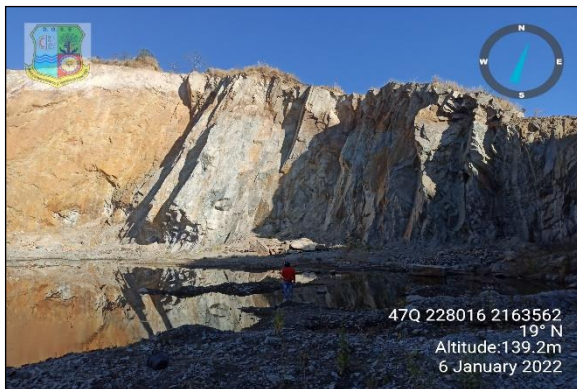
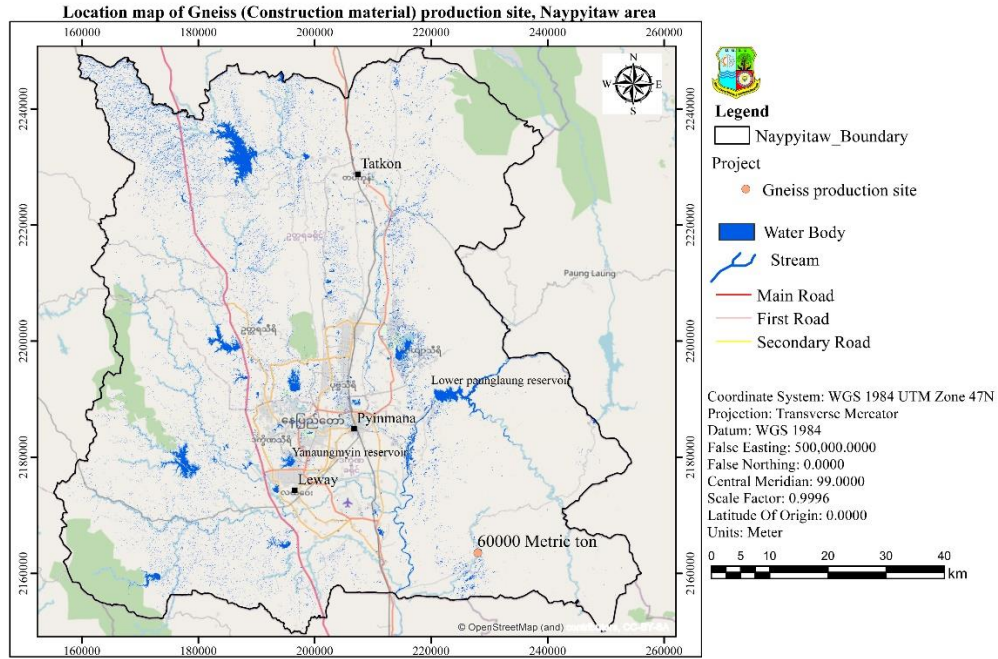


Figure 14. Gneiss quarry at Alinyaung quarry in Naypyitaw area



Figure 15. Photograph showing Gneiss at Alinyaung quarry in Naypyitaw area



Map 6. Location map of Gneiss (Construction material) production site, Naypyitaw area

4.7. Granite

Granite has coarse grain and contains Potash Feldspar and Quartz. Biotite mica can contain up to a proportion of one fifth. It contains few hornblende and muscovite mica. As the majority compound is feldspar, it is pale in color. The Potash Feldspar found in granite is mostly orthoclase or microcline and orthoclase is more common. Therefore the granite is pink in color (Dr U Thein, 1978). Granite can be found at UTM 2096-08 213754 E/ 2220917 N, Kuwa Village, Tatkon Township (Figure 16, 17) with the length of 50 meter, width of 30 meter and depth of 20 meter with lesser Joint Sets. White Granite with uniform granular size is being produced as the road filling rocks. In the white rock containing base quartz, Orthoclase feldspar and plagioclase feldspar, brown mica can be found as a cluster of sesames. On the surface of weathered granite, the stain from the brown mica turns the color to brownish yellow. Three types of Joint Sets can be found in the granite excavated in the plantation at Kuwa Village region. The main joint set is running from south to north with 60° dipping in the east. Second joint set is running from East to West and almost in perpendicular angle. Third joint set is running from northwest to south east. Rock Quality Designation is 90% and Uniaxial Compressive Strength is very hard. Granite of uniform granular size can be found at UTM 1996-06 220196 E/ 2187252 N, Eastern Bank of Paunglaung River, Kyitaung Village region. In the white rock containing base quartz, Orthoclase feldspar and plagioclase feldspar, brown mica can be found as a cluster of sesames. Three types of joint sets can be found in the Granite excavated around Kyitaung Village region (Figure 18, 19). The main joint set with direction of 340° running from NNW to SSE with 60° dipping to the east. The second joint set is running from East to West and almost in perpendicular angle. The third joint set can be found running from northwest to southeast. Boulder size with 3 meter in length, 2 meter in width, and 2 meter in high slightly foliated granite can be found at UTM 2296-01 219256 E/ 2184883 N, Wegyi Village, Zayarthiri township. Rock Quality Designation is 90% and Uniaxial Compressive Strength is very hard. In Kuwa Village Region, Granite is cut into 23 cm x 30 cm size to be used in building retaining wall and fence, laying ditch base, and 2.5 cm x 5 cm, 5 cm x 10 cm, 15 cm x 23 cm sizes to be used in road and construction works. Approximately of 9,000 metric tons of 30% safety factor obtained P-4 level can be remained. Slightly foliated granite can be found around Wegyi village region, Zayarthiri Township with approximate

availability of 36000 metric tons of 30% safety factor obtained P-4 level (Kyaw Kyaw Oo and Sat Pha, 2022) (Map 7).



Figure 16. Photograph showing Granite outcrop at Kuwa village

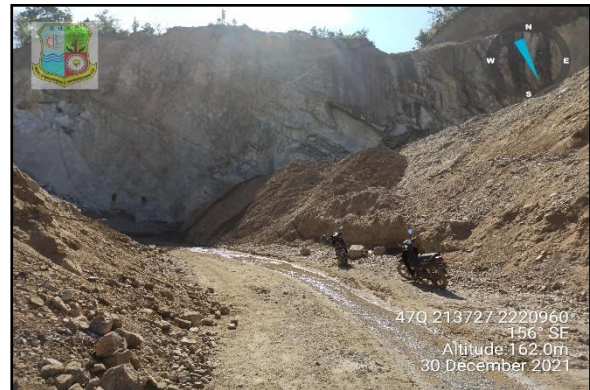


Figure 17. Granite Quarry at Kuwa village, in Tatkone Township



Figure 18. Photograph showing Granite outcrop at Kyitaung village, in Zayarthiri Township

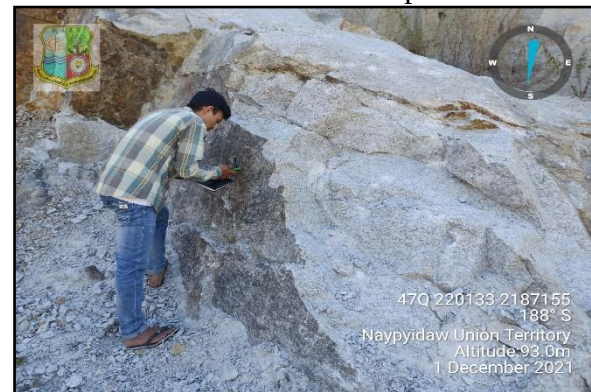
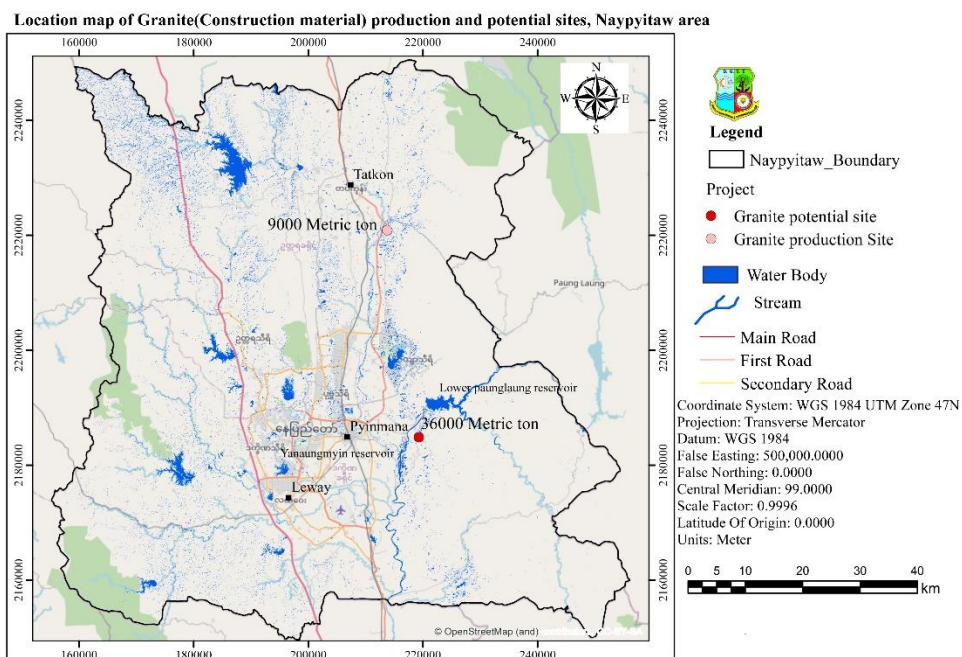


Figure 19. Photograph showing measuring joints of Granite



Map 7. Location map of Granite (Construction material) production and potential sites, Naypyitaw area

5. Conclusion

The quality and quantity of geological construction raw materials which can be found around Naypyitaw region, Union Territory are studied by dividing into two groups namely current production site and potential site. By drawing indicative map for construction materials, the available location, quantity and quality of construction materials for construction of State building, road, bridge and urban housing can be accessible. In excavating construction sands, the observation was made to ensure that if there are possible impacts on the water flow of river, the area of river and creek, and the area of river banks and around the banks. As sands excavated from Ngalike chaung and Sinthay chaung are small in granular size, they are used in landscaping, mixing cements and making cement for touching up the wall of the building. Sand excavated from Paunglaung River is bigger in granular size and is used in mixing cements for constructing Hydroelectric powerplants, Roads, Bridges, Dams and Reservoirs, and in purifying water for the dams and irrigation plants Naypyitaw Council region.

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