Geological Considerations of Surface and Subsurface Stability to Hold Civil Engineering Structures at Melkote

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Abstract

Melukotelying in 12°40'05" N 76°38'07" Ein Pandavapura taluk of Mandya district, Karnataka, in southern India isgeologically aGranitic and Mylonitic terrain. Karnataka being on hard rock terrain called Dharwar Carton, it has been further divided into Eastern Dharwar and Western Dharwar the eastern Dharwar being the youngest of two they have been sheared against each other forming Chitradurga schist belt a metamorphic terrain. In general the basement rock is Sargur schist belt 3.1 Ga old (billion years) overlain by Peninsular gneiss 2.9 Ga old (billion years) they have been over laying by younger Granitic rocks which is around 2.1 Ga old(billion years). This shows that the rocks are old and hard rocks and laying in Seismic ZoneII by BIS i.e. Bureau of Indian Standards. The even though they are hard rock terrains they have undergone structural deformations. Different structural features such as folds different sizes, faults different sizes, shears zones of different sizes running from micro shears of less than a meter to mega shears that run for hundreds of kilometers have been identified at different places. Hence the basic knowledge of this says that where ever we move around in Karnataka that would be on hard rocks of any of this kind. That is until and unless we encounter a mineralized terrain or structural feature the construction planning and execution would not be affected by the soft rocks or sedimentary rocks except a few basins such as Bhīma and Kaladgi Basin.

Coming to the geology of Melkote the place is known for huge hillocks or outcrops in geological sense and the have been recognized of extension of Bukapatna Granite of Chitradurga. The place is mylonictic terrain.Myloniteisanindicator of intense structural deformations such as faults, folds and shear zones. Hence the prime objective of Civil Engineer in the field is to identify the structural plains and then pre analyze the effect of the same on the civil structure that would be planed for. The rocks have undergone physical, chemical, biological, weathering. Chemical weathering processes are among the most fundamental natural processes operating at and near the surfaces of earth.

Keywords: *Granitic, Mylonitic, Sargur schist belt, peninsular gneiss and Mylonite.*

Figure 1: Block Joint

INTRODUCTION

The geology of Melkote is unique as it is having multiple considerations at a single place which has a geological setting of N10°S to NS alignment. It is mainly made up of granite, gneiss, pegmatite and Aplite Veins. Among the different rock types granitic gneiss are predominant.

At a stretch of mapping the simple details collected and annualized is that is a region of granitic terrain, which was interfered with the help of box joints or mural joints which occurs only in an igneous rocks. Another proof for the granitic terrain is the former rocks are fractured and folded later it has been filled by younger Quartz and Aplite veins (0.5 ma i.e. million old) which is not under any influence of metamorphic properties. Later it was absorbed that there were light green color tint of mica i.e. is a Biotite mica.

It says that the area was under metamorphic stress. Further to the colour change it was indicative that the mica has been hydrated either by ground water or surface water as the area has been eroded creating valleys causing change of colour in Mica. This on further hydration will yield to clay minerals like Kaolin. There are gneissicbanded trending granite at the valley region where Biotite was associated hence we can interpret that there are long and short run shear zones all along the area in which the mica and granite has been Metamorphosed.

Figure 2: Aplite Vein

Figure 3: Shear Zone Quartz and Mica

Figure 4: Pegmatite Vein

MINERAL AND ROCKS RESOURCES AS FOLLOWS:

MILKY QUARTZ: The quartz are said to be milky as the mineral has crystalized in an impure environment may be a small solid or gaseous impurity. These were found along the veins, it is this mineral that has been the first weathered in the zone.

Figure 5: Quartz Vein

MICA: The mica group of sheet silicate (phyllosilicate) minerals includes several closely related materials having nearly perfect basal cleavage. Mica is the general group name for several complex hydrous aluminum silicate minerals. All are monoclinic, with a tendency towards pseudo hexagonal crystals, and are similar in chemical composition. The nearly perfect cleavage, which is the most prominent characteristic of mica, is explained by the sheet like arrangement of its atoms.

Figure 6: Black Biotite Mica

SILLIMANITE: Sillimanite is an alumina-silicate mineral with the chemical formula Al_2SiO_5. They are usually associated with quartz mineral as a metamorphic origin or along plutonic and volcanic rocks. They are frequently retro graded to Moscovite, Sericite.

APLITE: This is a rock type which is absorbed only in more or less Granite and granitic gneiss. This is an intrusive rock in which mineral composition is the sameas Granite. Quartz and Feldspar are main composition. They are identified from their sugary texture.

Figure 7: Aplite Vein

GRANITE: This is the common rock type identified all over. Quartz and Feldspar being the main composition there is mica as well with other accessory minerals. They are having Equigranular Texture.

GNEISS: This is a type of rock observed have same composition as granite but they have different texture compared to granite. They are aligned horizontally in rows.

Figure 8: Gneissic Rock

GEOSTRUCTURAL CONSIDERATIONS FOR ENGINEERING PROPERTIES

Faults:

A fault is a planar fracture or discontinuity in a volume of rock, across which there has been significant displacement as a result of rock-mass movement. It has been observed that there are minor faults and a major shear fault might be the reason for shearing and in turn the cause for the valley.

Folds:

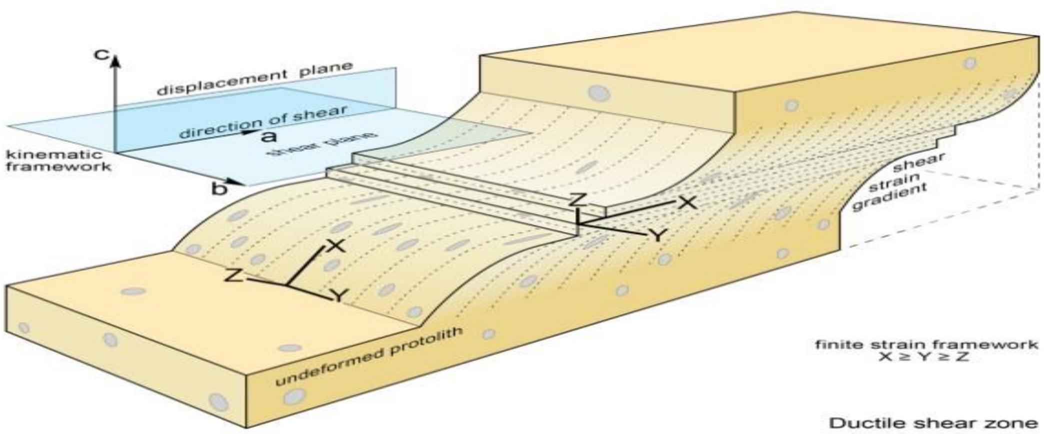
A geological fold occurs when one or a stack of originally flat and planar surfaces, such as sedimentary strata, are bent or curved as a result of permanent deformation. The fold structures were observed near Singapura at about two kilometers away.

Joints:

A joint is a fracture dividing rock into two sections that moved away from each other. Block joints were common everywhere and it helped to interpret the granitic rocks. Shear or closely spaced joints were also observed in the valley region.

Shears:

Ductile shear zones are long and narrow zones of relative displacement. They are analogous to faults but without fracture planes (unless they are reworked) because dominantly ductile deformation has caused the concentration of large strain into the shear zones. The formation of a ductile shear zone is commonly associated with a drastic reduction of grain size and the development of a well-banded and lineated rock called Mylonite. Ductile shear zones generally record a non-coaxial deformation and may range from the grain scale to the scale of a few hundreds of kilometers in length and a few kilometers in width. The strain gradients from Mylonite to undeformed rock are criteria to distinguish large-scale shear zones from regional deformation. Localization of deformation into such narrow zones reflects continuous but heterogeneous strain in rock.



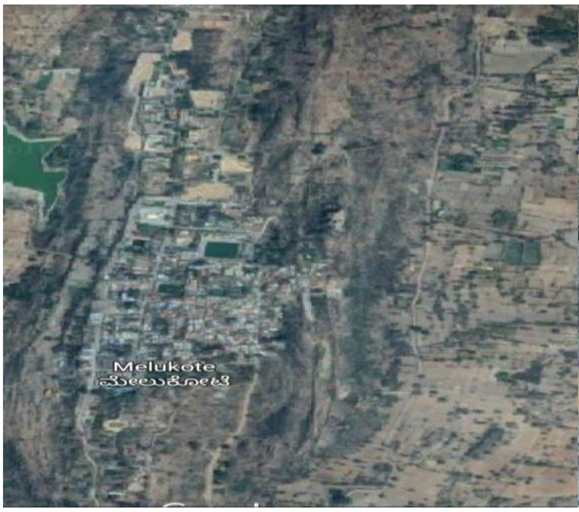


Fig 7: Areal view of Melkote

Fig 8: 3D view of the shear zone

CONCLUSION:

For safe, timely and economical execution of construction, adequate foundation treatment is essential to minimize any kind of post construction problems. The shear zone extending to large depth are encountered during excavation of the foundation, due to such weak zones the load of the structure can be transferred to the firm rock on the two sides. This leads to stress concentrations both in the rock and the structure.

With all the primary survey it was found that the shear zones and weak plains being the major setback for any typical civil structure, the same was observed in the study area.

After removal of shear material from the trench, the rock is exposed at the base of the trench. In between the two shear zone, the rock mass consist of hard minor fractures at places with minor seams Quartzo Feldsphatic Gneiss. The rock mass is slightly weathered to fresh. It is observed that the shear zone at left side of the excavated trench is pinching towards downstream side and gets bifurcated in upstream portion. The thickness of the shear zone at right side reduces towards downstream side. The Q value of the rock mass ranges from 1.5 to 4.5 class IV to III and in the shear zone portion it varies from 0.1 to 0.08 class V. The Rock Mass Rating (RMR) varies in jointed and blocky rock mass from 20 to 45 and GSI varies 15 to 40 whereas in shear zone RMR ranging from 10 to 15 and Geological Survey of India (GSI) 5 to 10.

Very often the exploratory drilling or final excavation uncovers faults, seams, or shattered or inferior rock extending to such depths that it is impracticable to attempt to clear out such areas entirely. These conditions require special treatment in the form of removing the weak material and backfilling the resulting excavations with concrete. This procedure of reinforcing and stabilizing such weak zones is frequently called "dental treatment."

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