Geological Assessment of 5.2 Km long alignment from Sahid Inder Singh Bargali motor road to Khanshyu motor road, Okhalkanda Block, District- Nainital.

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1- **Introduction**- Temporary Division, Public Works Department, Bhowali entrusted in construction of 6.80 Km long alignment from Sahid Inder Singh Bargali motor road to Khanshyu motor road, Okhalkanda Block District- Nainital. On the request of Shri A. B. Kandpal, Executive Engineer, Temporary Division, Bhowali I carried out geological assessment of the above said motor road. In 2018 a geological report is given for the same motor road, due to some changes in alignment again site visit is carried out on 29/05/2019. Junior Engineer Shri. Wahid Husen accompanied during the site visit.

2- **Location**- The link motor road starts from end point of Sahid Inder Singh malla–Okhalkanda motor road and ends at Km 4 of Khansyu-Tanda motor road. Sanction length of the road is 8.0 km but after survey total length of the motor road is coming 5.2 Km. the road consists of 6HP bends at 50m, 700, 1750, 2800, 4350, and at 5050m respectively. The gradient of road varies as- 0-100m 1:50F, 100-400 1:22F, 400-650 1:17F, 650-750 1:40F, 750-1700 1:17F, 1700-1800 1:40F, 1800-2750 1:17F, 2750-2850 1:40F, 2850-4300 1:17F, 4300-4400 1:40F, 4400-5000 1:17F, 5000-5100 1:40F, 5100-5200 1:17F. The co-ordinates of starting and end point taken from hand held GPS are as follows-

Starting Point
Latitude- N29°19'03.11"
Longitude- E79°44'18.12"
Elevation- 1572m

End Point
Latitude- N29°18'14.15"
Longitude- E79°44'08.19"
Elevation- 1092m

3- **Geological assessment:-** Geologically, the alignment corridor proposed for the above said motor road lies in part of Kumaun Lesser Himalayan Belt near to the Ramgarh Thrust. Ramgarh thrust separates the underlying autochthonous sedimentaries of inner and outer lesser Himalaya from the overlying low grade metamorphic unit of Ramgarh group. These autochthonous sedimentaries comprises of Quartzite of Nagthat Formation, which belongs to Jaunsar Group stratigraphically. The area lies in close vicinity of tear fault, which is an active fault trending in NNW-SSE direction. These fault/thrust system are controlling the river domain and drainage system around this area. Ramgarh Group comprises of Phyllite, Schistose Quartzite, and Carbonaceous Phyllite of Nathuwakhan Formation and Porphyroid of Debguru Formation. The rocks i.e. Augen Gneiss of Debguru Formation occupies this area.

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Topography of the area overall is gentle to moderately steep. Area is covered with forest. Some manmade terraces were also observed which are mostly cultivated in the first few km's rest of the area is much steeper and is mostly covered with forest. Slope angle varies from place to place. Slope angle ranges from 25°-75°. No prominent nala is observed at the site. Hydrological conditions are mainly dry, except in rainy season. Largely the rocky strata along this alignment are capped by thin overburden material which varies in thickness from place to place and overall less than 1m. Soil cover is less than 1 m and has clay content. The soil is good cohesive, dense and hard in dry conditions but these converts into soft clays under the wet/saturated conditions.

Weathering condition is moderate to high in the area. Approximately at 525m slide portion is observed behind the school boundary before second hp bend. The slope comprises of highly deformed and weathered rockmass of older landslide deposit having very low strength. Tilting of tress also suggests slow creep movement (Fig. 4).

Rock type in the area is Phyllitic Quartzite and Augen Gneiss, which is hard and compact in strength. Quartzite is more deformed, fractured and weathered than the gneiss. Strength of the rock is estimated with manual test. At some places the rock is highly sheared and weathered. High grade of deformation is observed at the starting point, rocks are highly deform and weak. Four sets of joints have been observed at the site (Table- I). Joint J1 is very closely spaced then the other joint sets. The filling in-between joint plane is clay. Joint sets recorded from the outcrop are as follows-

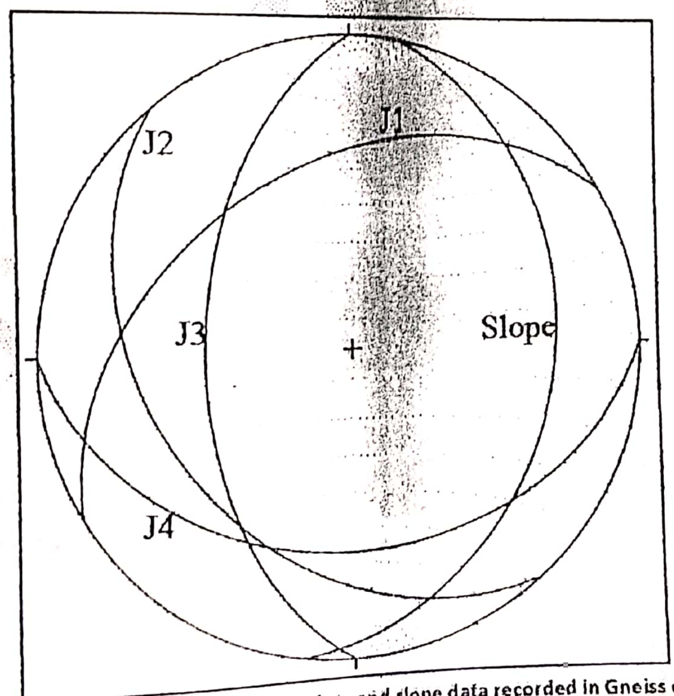

Figure 1 Stereographic projection of joints and slope data recorded in Gneiss outcrop.

From the above stereographic projection (Fig 1) it is clear that due to intersection of Joints J1, and J2 is forming wedge in slope direction which is prone to failure, if any joint

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or tension crack acts as a releasing surface along the alignment then the wedge failure can occur.

Table I

S. No.	Feature	Azimuth	Direction
1	F/J1	40°	N330°
2	J2	35°	N230°
3	J3	50°	N270°
4	J4	35°	N180°
5	Slope	30°	N300°

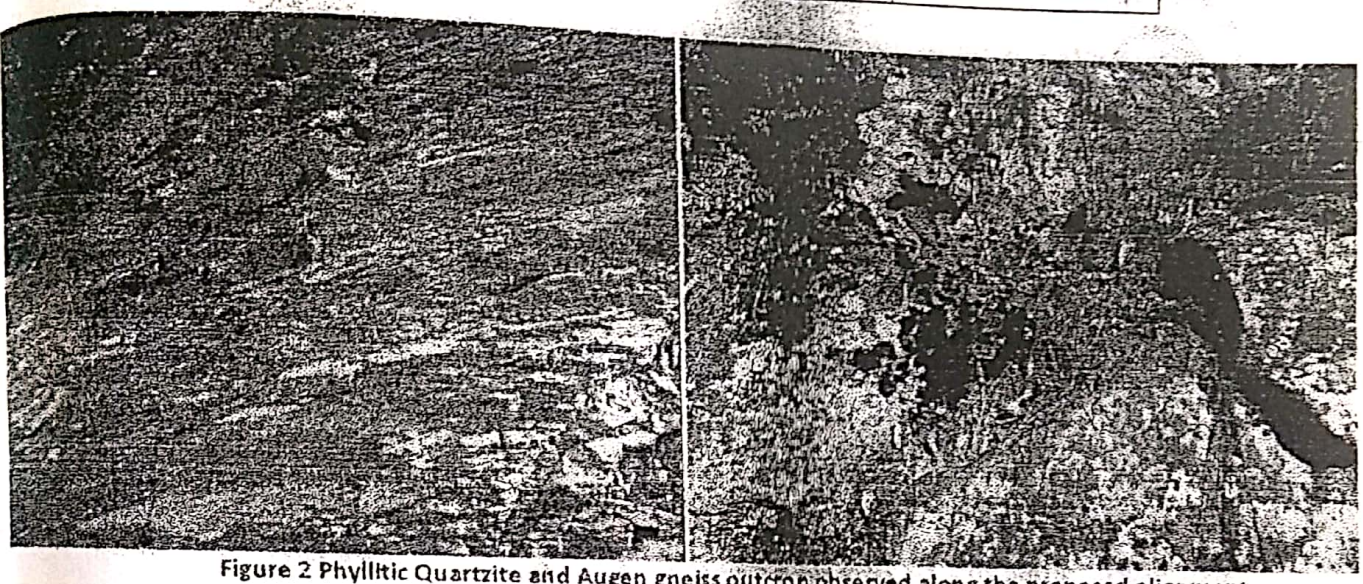

Figure 2 Phyllitic Quartzite and Augen gneiss outcrop observed along the proposed alignment

Figure 4 Tilting of trees observed behind the school also the slope comprises of previous landslide deposit.

On the basis of the geological/geotechnical studies carried at the site and the fact mentioned above the following recommendations are being made for the construction of the proposed road, failing to these recommendations this report will be treated as cancelled. This report is the revised geological report of the same alignment. Previous report with Letter No: 5385 / 09 स०भू०वै०/18 Dated: 13/12/2018 should be treated as cancelled.

4- **Recommendations**-

1- Do not blast heavily by explosives. It is recommended that the blasting shall be carried out by controlled method i.e. by leaving large volume of dummy holes.

2- The entire hill and valley side slope along the whole length of the road must be protected by suitably designed retaining/ breast walls. This work should be done simultaneously with the advancement of the road cutting. It is advised to leave sufficient weep holes in the walls, this is so as to facilitate the subsurface drainage.

3- Properly designed culvert/bridges/scupper must be constructed over the nala whichever is suitable.

4- Gradient of the road must be improved as in the entire road the gradient is low as 1:17 and due to continuous hp bend same slope is cutting regularly this will affect the

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stability of the slope. Along with this HP bends must be constructed with standard gradient and protection must be given on the hill side to retain the slope.

5- Construct U shaped lined drain all along the hill side of the road and made adequate cross drainage arrangements. The accumulated rain water from upper reaches of the hill must not allow to flow freely over the road constructed and its lower hill slopes.

6- Disposal of muck and excavated waste on the lower slopes of this road is to be strictly avoided. It is advised to dispose the muck on the identified site for muck disposal.

7- The por .on of the road which passes through the cultivated field where water seepage from the ground is high; RCC should be done.

8- Proper protection must be given on the first km and behind the school boundary in both upslope and down slope region as the area comprises of deformed rock. Also protection must be given to prevent failure anywhere along the alignment during and post construction.

9- Illegal excavation of rocks must be stopped; as the rocks are highly fractured it will affect the stability of the slope.

10- All the construction activities must be carried out as per the prescribed norms and the standard codes of the practice laid by BIS and MORTH.

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