GEOLOGICAL REPORT

ABSTRACT:

It is proposed to construct 9.653 km section of motorable road from Jaurasi to Tonji, Dist. Chamoli, by Public Works Department. It was required as per the work order to conduct a detailed geological investigation along the proposed alternative alignments to select the best alignment on the basis of the said investigation. The aim of geological investigation is to collect suitable data and information regarding general topography and geography of the area including type of rock formation along the alignment. The location and direction of faults and joints if any, have also been recorded. On the basis of the data collected from the site, best alignment has been selected considering the stability as the prime requirement. While selecting the alignment, it has been kept in mind that ecological and environmental imbalance is not caused in the concerned area during the construction of the road and even afterwards when the road becomes operational. Necessary precautions to be taken along with some suggestions have also been mentioned so as to facilitate the construction of motorable road on this part of the nation.

LOCATION:

Chamoli district lies in the north-eastern part of Uttarakhand state. It is bounded by North Latitude 29º 55' 00" & 31º 03' 45" and East Longitude 79º 02' 39" & 80º 03' 29" and falls in Survey of India topo-sheet nos. 53O/ M and N. The geographical area of the district is 7820 sq km. Chamoli district the second largest district of Uttarakhand, is also important from strategic point of view as it shares its northern boundary with Tibet (China).

1. This road alignment starts from village Jaurasi situated at Pokhari – Gopeshwar road.
2. The alignment ends at village Tonji.

GENERAL GEOLOGY AND TOPOGRAPHY:

REGIONAL GEOLOGY AND STRUCTURE OF THE HIMALAYAS:

The geological formation in Himalayas takes sharp turn forming hair pin bends at the Eastern and Western extremities of the arc, and continue Southwards into Burmese and Baluchistan arcs respectively. These two points of acute inflexion constitute the major syntaxial bends in the Himalayas.

The Lesser Himalayas are composed of tectonically compressed blocks of Paleozoic and Mesozoic crystallines, metamorphic and sedimentary rocks. The main central thrust is a major tectonic feature of the Himalayas and has brought the crystalline rocks of Higher Himalayas over the younger Sedimenterries.

The Higher Himalayas consists of a single range with an average height exceeding 6,000m. The width of this zone, mostly composed of Granite and Gneisses, is 24km. The central crystalline occupy the core of the axis of the range and are considered as tertiary intrusive accompanying the compressional movements responsible for the uplift of the Himalayas.

GEOLOGY OF CHAMOLI AREA

The main lithological units in this region are: Vaikriata group, Musiari, Tejam, Berinag and Damtha formation. The Vaikrita group of rock are part of higher Himalayas and consists of higher grade metamorphic rocks of granite and gneisses. Precambrians are exposed in the area North of Chamoli. The Ramgarh group consists of crystalline rocks of predominantly Quartzites and sediments exposed Southward of Chamoli. The crystalline rock of metasediments and acidic intrusives are exposed near Siraupani and North of Chamoli. The Klippen Zone of Almora are medium grade metamorphic covering large part of the area and form the border located South of Vaikrita group of rock.

The boundary between the high grade metamorphic rocks of Vaikrita group and low grade metamorphic rocks of Almora group is Vaikrita thrust, defined as Main Cenral Thrust (MCT). The MCT has also been identified as a Zone of ductile shearing and thrusting, dipping about 30^0, Northward manifested essentially in abrupt change in structures and grade of metamorphism. The well-mapped faults in this region are the Alaknanda fault near Karanprayag and the Gopeshwar fault extending MNW-SSE direction from Nandprayag to Gopeswar.

Geologically the area belong to the Lesser Himalayas and lies in a tectonic fore deep. The Lesser Himalayas are comprised of fanglomerates followed by bedded quartzites, slates, phyllites and low-grade schists. The rock types are ranging from green schist to lower amphibolite facies. The main rock types are schists, phyllites and quartzites.

Central Crystallines:

The central crystalline rocks are well exposed in the Higher Himalaya of Alaknanda valley of district Chamoli. The rocks of Central Crystalline Group form the oldest crystalline basement of the Himalaya. The gneisses, migmatites, crystalline schist, thick quartzite with conspicuous horizons of calc-silicates with psammite gneisses in the upper part form bulk of the metasediments. The major geological formations of the Central Crystallines along with the lithology are given in Table 1.

Garhwal Group (Supersequence): Palaeoproterozoic

The Garhwal Group forms the most extensive Group of rocks in district Chamoli. The rocks of palaeoproterozoic time-span are grouped in Garhwal Group. It forms the major part of the Lesser Himalaya and is represented by thick sequence of low-grade metasediments consisting of quartzite with penecontemporaneous mafic metavolcanics and carbonate rocks. Garhwal Group is limited in the north by the Main central Thrust and in the south by the Main Boundary Fault. The Garhwal Group consists of quartzite, phyllite, slate and limestone. Acid and basic igneous rocks intrude the Garhwal Group.

Table 1: Major geological formations of the Central Crystallines along with the lithology

GEOLOGICAL FORMATION	LITHOLOGY
Badrinath	Garnet, Sillimanite, Muscovite and kyanite, migmatites, calc-silicates. Leucogranite, pegmatite and garnet amphibolite.
Pandukeshwar	Banded quartzite gneiss and interbedded quartz mica-schist, para-amphibolite
Joshimath	Garnet mica-gneiss, staurolite and kyanite-gneisses, garnet amphibolite.
Bhimgora	Quartzite White quartzite with gneiss and schist Ragsi Mica-schist.

Valkrita Group: Mesoproterozoic to Neoproterozoic

Valkrita group (Supersequence) of rocks represents the higher-grade metamorphics of the Higher Himalaya pervasively penetrated by young Tertiary granite. The rocks comprising, this group, are micaceous schists, talcose rocks, phyllites and gneisses overlying mainly the granite gneisses. Spatial extension wise the Vaikrita Group includes the metasedimentaries exposed between the granite-gneisses constituting the Central Crystalline and the overlying Martoli Group and its equivalents. The granite intrudes both the Vaikrita and Martoli Groups and includes biotite granite, tourmaline granodiorite, tourmaline aplite and pegmatite.

Lesser Himalaya (Supersequence): Mesoproterozoic to Neoproterozoic

This supersequence, in Lesser Himalaya, is represented by two groups, viz. the older Jaunsar Group and the younger Dudatoli Group. These two groups are briefly described below.

Jaunsar Group:

The rocks of this group are continuously exposed in the outer Lesser Himalaya. In Chamoli district it is exposed in the southwestern part. It is divided into three formations, viz. Mandhali, Cahndpur & Nagthat, and consists mainly of phyllite, quartzite and slate

Tethys Himalaya:

Martoli Group is represented by a thick sequence of unmetamorphosed to feebly metamorphosed rocks in district Chamoli. The rocks of this group are exposed Alaknanda River basin. The main rock types are silver grey phyllite with interbedded thin quartzite

Kamet, Mana, Trishul, Chaukhamba, Dunagiri, Nandakot, Hathiparvat, Neelkanth, Nar & Narayan parvat. The slopes of these peaks are covered with glaciers. These peaks are separated by the traverse, deep, narrow gorges of Alaknanda, Saraswati, Dhauli Ganga, Birhi Ganga, Rishi Ganga, Kail, Pindar, Nandakini rivers. Glaciers, horned peaks, cirques, hanging valley etc, sculpture this zone. The morainic materials occupy the valleys areas. The prevalent landforms are lateral moraines, end moraines, U-shaped glacier valleys, V-shaped fluvial valleys, river terraces and Denudational Structural Mountain.

CLIMATE

The climate varies from Sub-tropical monsoon type (mild winter, hot summer) to tropical upland type (mild winter, dry winter, short warm summer). The northern, northwestern, northeastern and western part of the district is perennially under snow cover; here the climate is sub-arctic type as the area is represented by lofty Himalayan Range. Severe winter and comparatively higher rainfall are the characteristic features of the northern part. The year may be divided into four seasons viz. the cold winter season, (December to February), the hot weather season (March to May), southwest monsoon season (June to September) followed by post monsoon season (October to November). The normal maximum and minimum temperature varies between 31 and –2.9ºC respectively.

Larger part of the district is situated on the southern slopes of the outer Himalayas, monsoon currents can penetrate through trenched valleys, the rainfall reaches its maximal in the monsoon season that spans betweens June to September. Rainfall, spatially, is highly variable depending upon the altitude. In the Lesser Himalayan Zone (1000-3000m amsl) maximum rainfall occurs about 70 to 80% in southern half. August is the rainiest month. Rainfall rapidly decreases after September and it is the least in November. About 55 to 65% rainfall occurs in the northern half in Central Himalayan Zone. About 17% of the annual precipitation occurs in winter season. The winter precipitation is in association with the passage of the western disturbances and is mostly in the form of snowfall, particularly at higher elevations. The precipitation during the pre-monsoon month, which is about 7% of the annual total and the post-monsoon months, is frequently associated with thunderstorms. Its average normal annual rainfall is 1230.8mm.

GEOLOGICAL STATE:

This road alignment is spread over Jaunsar group of Lessar Himalayan Region and consisting mainly of phyllite, quartzite and slate. Quartzite rocks are visible at some places having layer of soil and debris of varying thickness over them. These rocks have fault with a direction of EW and thrusts as shown in the diagram. Upper strata of the rock formation is of medium hardness. This upper formation is mainly of Phyllites and slates. After this, Quartzite formation is apparent with rocks of heavy hardness.

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gical tectonic formation at the site under consideration is represented as

Layer of soil

Debris

Phyllite or Slate

Quartzite

anges from medium to steep all along the alignment.

ONSIDERATIONS:

prime consideration while proposing and designing a hilly road due to tough itions almost during the entire span of a year, sometimes due to rains and ue to snow. On the basis of the finally selected and approved alignment, it is to give due considerations to following points regarding construction of road, keeping topographical, geological, ecological, seismic and environmental mind:

ite is in hilly terrain.
area falls in the seismic zone V.
re are villages near starting and end points of the alignment.
ny dry nallahs are crossed by the alignment.
logy and environment of the area should be kept in mind while construction of e road.
ire alignment falls in cultivated land and passes through built up area at few cations.
ape of hill ranges from normal to medium.

STIONS:

geological, seismic and ecological constraints in mind, and to ensure overall stability constructed road in particular and the concerned area in general, following ions are made for the construction of the proposed motorable road:

A drain should be constructed by the side of the hill all along the road in cutting.
Breast/retaining wall should be constructed as per shape of the rock and site requirement.
Scupper/double scupper /culvert/causeway should be constructed at the location of dry nallahs.

4. Outer edge of the road should be kept higher than the inner one at the locations of debris/mud, so that water does not cross the road during rainy season and road remains safe for driving.
5. Road should be constructed keeping ecology and environment in to consideration.
6. Use of Explosives should be avoided near villages.
7. Provisions should be made as per specifications set for construction of motorable road in hilly terrain.
8. Suitable provisions should be made for earthquake.
9. Other provisions as found necessary should be made.

CONCLUSION:

Keeping the points discussed above into consideration, it seems advisable and feasible to construct a motorable road in this area along the proposed alignment.

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