

कार्यालय प्रमुख अभियन्ता एवं विभागाध्यक्ष
उत्तराखण्ड लोक निर्माण विभाग,
देहरादून।

भू - गर्भीय निरीक्षण आख्या एस0जी0- 671/सड़क/पुल समरेखण/ गढ़वाल/2014

**Geological Assessment of the alignment
corridor proposed for widening of NH-123 (507)
between km 75.00 to km 101.00 section.**

29-दिसम्बर-2014

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Geological Assessment of the alignment corridor proposed for widening of NH-123 (507) between km 75.00 to km 101.00 section.

1- Introduction: - National Highway Division 10, Public Works Department, Barkot has proposed widening of NH- 123 between km 75.00 to 101.00 the section located within the district boundaries of Uttarkashi Thatri Khudd to Murari Gaon, near Naugaon Block. On the request made by the Executive Engineer, NH Division, Barkot in order to make geological assessment I carried out the geological/ geotechnical assessment of the above section of NH, on 28.12.2014 in presence of Er. V.P Dobriyal, Asstt. Engineer, NH, Barkot.

The stretch proposed for widening of the Highway lies on the right bank steep slopes of Yamuna River which are low, moderate, steep to near vertical at places and are occupied by the in situ rock masses along with the earth and boulders. In most of this section the road widening will be achieved by back cutting of the hill slope which are comprised of anisotropic, heterogeneous material and the grade of inclination of the hill slope changes frequently all along the proposed excavation/widening.

2- Geology of the area: - Geologically the area comprising the section of the NH and it's environs lies in the Garhwal lesser Himalaya of Main Himalayan Belt (MHB) which is tectonically bounded by two major dislocations of regional dimension namely the Main Boundary Thrust (MBT) and Main Central Thrust (MCT) located in it's south and north respectively. Mostly the rocks exposed in the area belongs to Damta Tejam Group, Jaunsar and Ramgarh Group. The in-situ rock masses are well exposed in this stretch of the National Highway. The rocks of Damta Group and Tejam Group forms the bulk of the lithotectonic unit and the rock masses these are traversed by various linear discontinuities like rock defects, joints, shears, faults etc. Most of these rock masses are sheared / shattered, open and infilled by clay / crushed rock material or these are sealed by the secondary inclusions like quartz veins.

The following provides the Kilometer wise description of the material encountered along this section of road widening.

- Km 75:- 60% Rock Mass Strength Rock; massive, widely spaced jointed at places sheared/shattered/deformed.
40% Earth and Boulder- Semi-dense, partially dispersive, "Stiff"
- Km 76:- 75% Rock Mass 25% Earth and Boulder-
- Km 77:- "Uniaxial Compressive Strength":- > 250 M P
25% overburden:-Earth and Boulder- Heavy Soil (soil mixed with boulders)
Less cohesive, semi dispersive, semi consolidated/dense
- Km 78:- 20% Rock Mass-Properties more or less similar to the described earlier.
80% overburden- Properties more or less similar to the described Earlier.
- Km 79:- 100% rock mass- Properties more or less similar to the described earlier.
- Km 80:- 80% rock mass- Properties more or less similar to the described earlier.
20% Earth and Boulder- Properties more or less similar to the described earlier.

- (125)
- Km 81(Sarigad):- 40% Rock mass- Properties more or less similar to the described earlier.
60% Earth and Boulder- Properties more or less similar to the described earlier.
- Km 82:- 70% Rock Mass- Properties more or less similar to the described earlier.
- Km 83:- 50% Rock Mass
50% Earth and Boulders
- Km 84:- 80% Rock Mass
20% Earth and Boulders
- Km 85:- 90% Rock Mass
10% Earth and Boulders
- Km 86:- 40% Rock Mass
60% Earth and Boulders
- Km 87:- 100% Earth and Boulders
- Km 88:- (Barnigad section)-
30% Rock (phyllites/slates) sheared/shattered UCS=5 M Pa 10 M Pa RQD=20% - 35%
70% Earth and Boulders River Born Material (RBM)-UCS=5 M Pa 10 M Pa.
- Km 89:- 10% Rock Mass
90% E&B, River Born Material
- Km 90:- 20% Rock Mass (Dolomites)
80% E&B, River Born Material.
- Km 91 (Steep Slope Facets:-
90% Rock(Phyllites/Slates, Foliation planes dipping outwards to slope face.
10% Earth and Boulders
- Km 92:- 100% Rock Mass
- Km 93 (Steep Rocky Slopes:-
90% Rock Mass
10% Earth and Boulders
- Km 94:- 100% Rock Mass M Pa 10 M Pa.
- Km 95:- 40% Rock Mass
60% Earth and Boulders
- Km 96:- 60% Rock Mass (Massive Quartzites, thinly foliated slates)
- Km 97:- 60% Rock Mass (Massive Quartzites, thinly foliated slates)
40% Earth and Boulders(Massive Quartzites, thinly foliated slates)
- Km 98:- 90% Rock
100% Earth and Boulders
- Km 99 :- Terraces& fields, moderate slope angle (Naugam Market)
100% E&B, well consolidated, dense and non dispersive.
- Km 100:- 30% Rock Mass Terraces& fields, moderate slope angle
70% Earth and Boulders Terraces & fields, moderate slope angle
- Km 101:- 100% Earth and Boulders- low to moderate slope angle.

Joint Sets are recorded along the proposed stretch of widening are given in the following table 1

| S.No | Feature | Dip angle | Azimuth |
|----------------|--------------------|-----------|-----------|
| 1 | 2 | 3 | 4 |
| J ₁ | (So bedding joint) | 40°-48° | N020-N050 |
| J ₂ | joint | 45°-65° | N290 |
| J ₃ | joint | 80° | N310 |
| J ₄ | joint | 70° | N075 |

The rock masses exposed along the road sections are quartz arenites, quartzites, slates/shales and dolomites and at places these are overlain by the overburden material comprising of hill wash/slope wash material (composite material of soil and angular rock fragments) and river born material (RBM) of varying thickness ranging from thin 0.50 m to thick upto >15 meters order.

3- Geotechnical Assessment:-Geologically most of the area is occupied by the rocks belonging to Lesser Himalayan sedimentary sequences which are folded/faulted and destressed in nature. The rock masses exposed along the proposed alignment are massive to thinly foliated, partially weathered, and at places deformed. The rock masses along the proposed widening section are dissected by various rock defect sets (joints) which are at places open in nature and infilled by the crushed rock and clay material. Most of the joint sets are smooth, planner, wide to closely spaced but most of these have considerable strike continuity. The slope facets of the proposed widening section at places are controlled by thesed joints especially at places where they strike more or less parallel to the slope facet and are inclined at low angle to the slope. Likewise the intersection of two adversely oriented rock defect sets form the structural wedges at many places which may fail along the plane of intersection, if left unsupported after the excavation. Therefore, before at the time and after the excavation of hill slopes, expert advise must be obtained from any experienced engineering geologist in order to maintain the hill slope stability.

The slopes across the proposed widening section are generally inclined at low (15°) 20° cliff like 85° oriented in the SW to NW directions. At places these slopes are exposed with the overburden / slope wash material comprising of angular boulders embedded in clay silt matrix. No traces of the major shear/ fault zone were identified but a number of minor shear zones encountered frequently along this road widening section which are mostly infilled by clay gauge of 2-10 cm thick .

In order to excavate the hill slope rough guide line for the slope or cuts in rock and earth and boulder exposed along the road section is given in Table 2, however in adopting this table, caution must be exercised with the help of experienced geologist. The factors such as the influence of dip in relation to the inclination of the slope face, the nature of joints (rock defects), hydrological conditions etc. must be taken in account at the time of the excavation on the hil slope.

Table-2

Slopes for Bed Rocks Cuts along the proposed road section.

| S.No. | Rock Type / Overburden Material | Range of persistence slope Horizontal: vertical |
|-------|-----------------------------------|--|
| 1 | Nagthat Quartzites | $\frac{1}{4}:1$ to $\frac{1}{2}:1$ |
| 2 | Dolomites/Quartz arenites | $\frac{1}{2}:1$ to $\frac{3}{4}:1$ |
| 3 | Interbedded Quartzite's/Phyllites | $\frac{1}{2}:1$ to $\frac{3}{4}:1$ |
| 4 | Earth and Boulders | 1:1 |

By and large the alignment slopes are presently stable and free from any active landslide/mass wasting activities.

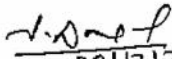
On the basis of the geological / geotechnical studies carried at the site and the facts mentioned above the following recommendations are being made for the widening of the above said stretch failing to these this report will be automatically treated as cancelled.

4- Recommendations:-

1. Excavate the hill slopes as per the recommended cuts i.e. mentioned in Table 2 of this report, and way out to wider the road in Khudd side where the slopes are gentle and the ground permits for walling etc.
2. Do not blast the rocks heavily by explosives. Otherwise extract the rocky material by controlled blasts i.e. 1 charged to half dia and 4 dummy holes (completing empty) and ensure that half drill mark is left on the rocky slopes after the extraction.
3. In the entire stretch of the road wider section located on the upslopes of villages the road must be constructed by cement concrete laid shoulder to shoulder and make large arrangements for the disposal of rain water from the road in the stable ground.
4. The hill side slopes of the entire road must be protected by suitably designed retaining walls/breast walls, this work shall be carried out simultaneously with the advancement of the road cutting. This is very important for the stability of the hill side slopes.
5. The entire surface of the road from outer edge to inner edge must be sealed immediately after the excavation, this is so as to check the water infiltration into the sub soil, otherwise the slope will fail and threat the safety of the village on its lower slopes.
6. Construct extra large lined drain all along the hill side of the road and make adequate cross drainage arrangements. The accumulated rain water run-off from this road and its upslope catchment should not allow to flow freely over the villages or on the slopes located in its downhill slopes.
7. Do not dispose the excavated waste on the lower slopes.
8. All the construction activity must be carried out as per the standard codes of practice laid by the BIS and MORTH.

5- Conclusion:- On the basis of the geological / geotechnical studies carried at the site and with the above recommendations, the road section was found geologically suitable for the widening of NH- 123 between km 75.00 to 101.00 the section located within the district boundaries of Uttarkashi Thatri Khudd to Murari Gaon, near Naugaon Block, Distt. Uttarkashi.

NOTE:- This report is beibng generated only for the purpose of land transfe, geologically it is recommended to carry out all the works, prior, during amd post excavation in the supervision of any qualified/experienced engineering geologist/geotechnical engineer.


29/12/2014
(Vijay Dangwal)


Sr. Geologist
Office of the Engineer in Chief,
PWD, Dehradun.


कार्य का नाम:- उत्तराखण्ड राज्य द्वारा प्रस्तावित जनपद उत्तरकाशी में राष्ट्रीय राजमार्ग सं० 123 (507) थाथरी खड्ड से मुराडी गांव के पूर्व निर्मित मोटर मार्ग के किमी० 75.00 से 101.00 तक के भाग का दो लेन चौड़ीकरण हेतु वन भूमि हस्तान्तरण प्रस्ताव।

(लम्बाई-28.00 किमी०)

भू-वैज्ञानिक की संस्तुतियों/सुझावों का अनुपालन किये जाने का प्रमाण पत्र

प्रमाणित किया जाता है कि विषयगत परियोजना के निर्माण हेतु भू-वैज्ञानिक द्वारा दिये गये सुझावों/संस्तुतियों का अनुपालन सुनिश्चित किया जायेगा।


कनिष्ठ अभियन्ता
रा०मा०खण्ड, लो०नि०वि०
बड़कोट


सहायक अभियन्ता
रा०मा०खण्ड, लो०नि०वि०
बड़कोट


अधिशाली अभियन्ता
रा०मा०खण्ड, लो०नि०वि०
बड़कोट