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**Geological Assessment of 10.0 km long Patal Ganga-Ganaai-Molta Motor
Road Alignment corridor between Chainage 0.0 to 10.0 Km,
District Chamoli (Garhwal)**

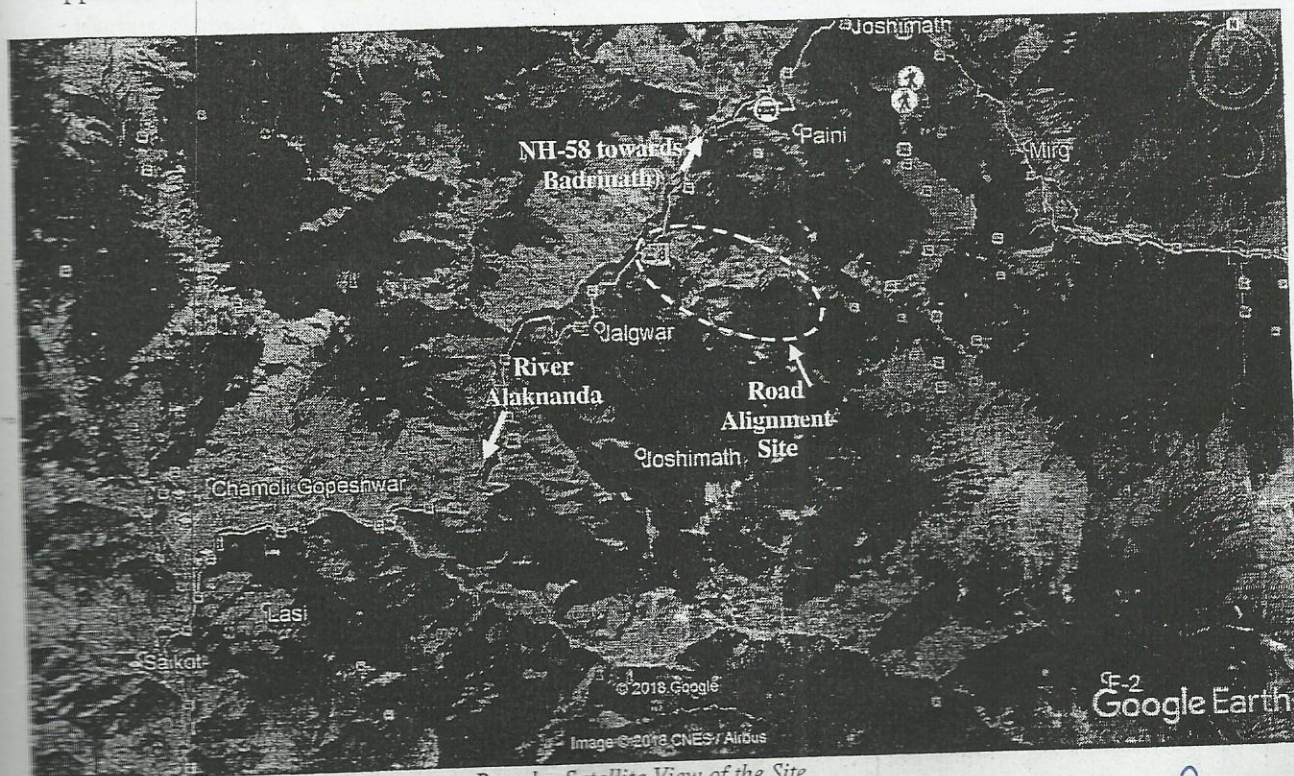
Tushar Sharma

16/12/2017

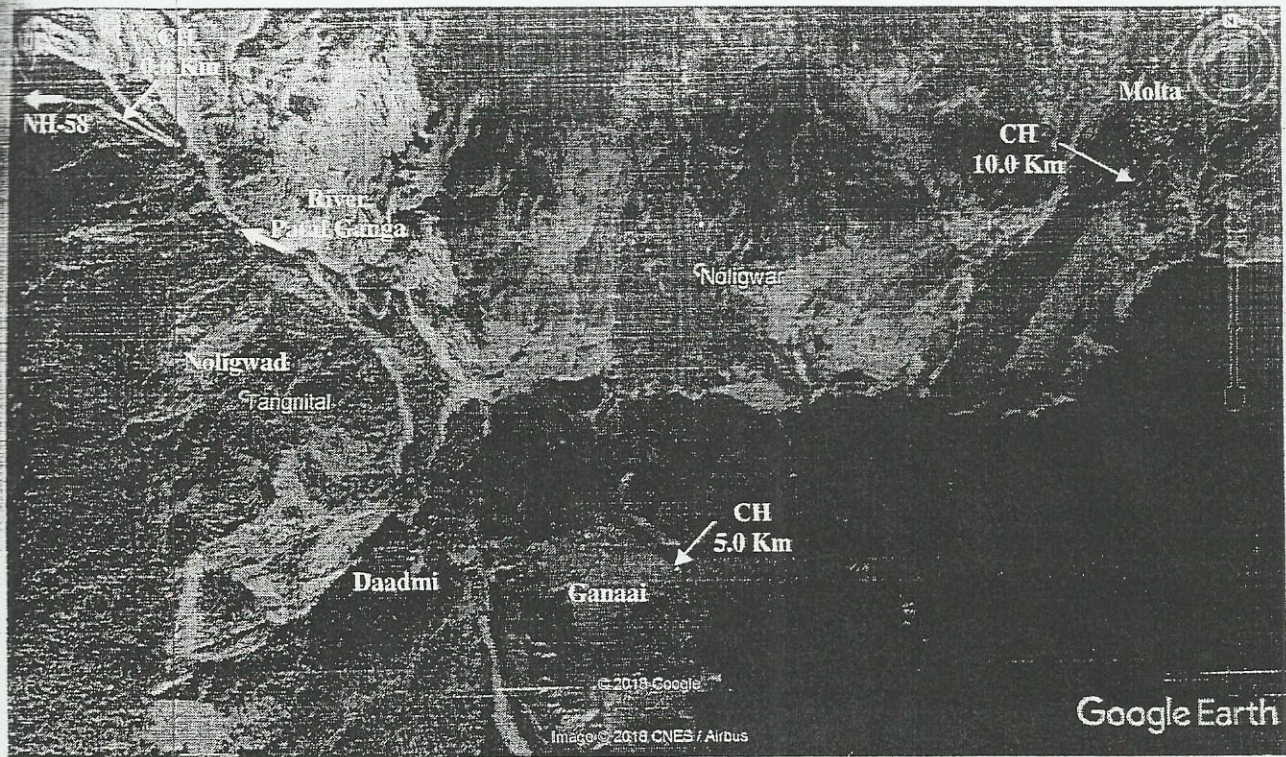
1- Introduction: The Provisional Division, PWD, Gopeshwar Garhwal has been entrusted for the construction of a 10.0 km long Patal Ganga-Ganaai-Molta Motor Road in District Chamoli (Garhwal). In order to assess the alignment site for construction, Er. Dhan Singh Rawat (Executive Engineer) Provincial Division, PWD, Gopeshwar asked for a geologist to make a site visit. Consequent to his request a site visit was made on 30/11/2017; Er. Shivam Mittal (Assistant Engineer) and Er. Ashok Maikhuri (Junior Engineer) of PD PWD, Gopeshwar were present during the site visit.

2- Topographical Information/Location: The above mentioned road alignment divertss from Km 460 of NH-58 (Delhi-Haridwar-Badrinath Motor Road) at Patal Ganga which is located about district Chamoli (Garhwal). The co-ordinates along with elevation, masl of the site at CH 0.0 m are as follows-

Latitude	: 30° 29' 10.00"
Longitude	: 79° 29' 13.25"
Approximate Elevation	: 1435 M

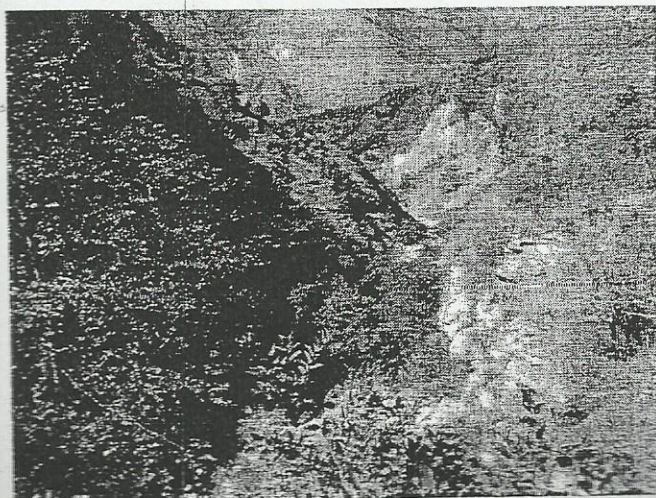


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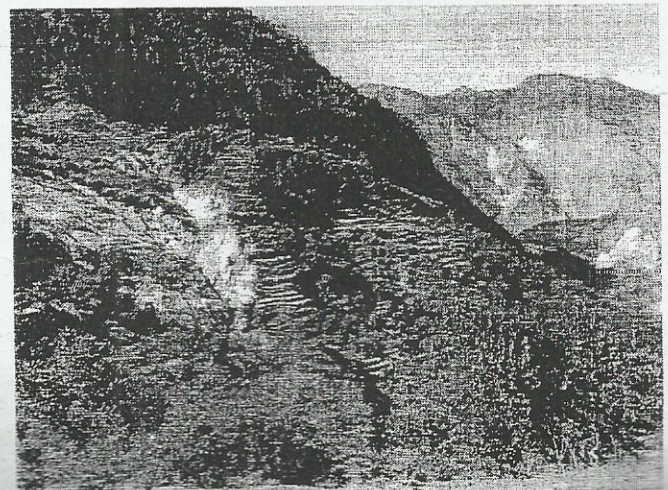


Closer Satellite View of the Road Alignment Site

- 3- **Geological Assessment:** Geologically, the area falls in the vicinity of MCT (Main Central Thrust) which separates Meta-sedimentaries rocks of Lesser Himalaya with Crystalline rocks of Higher Himalayan zone, described as the Himadri Complex by (Valdiya, 1973; Valdiya and others, 1999). The rocks exposed around the site are hard Dolomitic limestone to Limestone belonging to Deoban and Mandhali Formations of Tejam group; these rocks at places are highly weathered jointed and fractured. Also due to the vicinity of the area with MCT several fault/thrust related features like landslide, weathered/fractured/pulverized rocks were observed all along the valley. The hill slope of the site area is moderate to steep which declines at $\sim 25-50^\circ$ roughly towards north direction. The road alignment passes through cultivation land (Naap & Civil) with patches of bed rock.



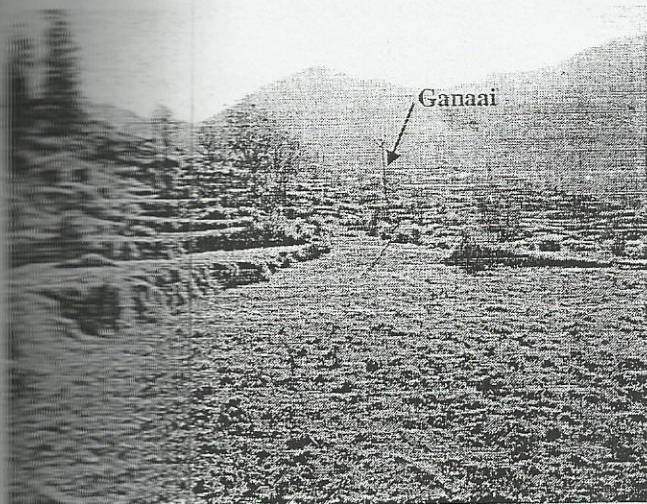
Down stream view of alignment site valley



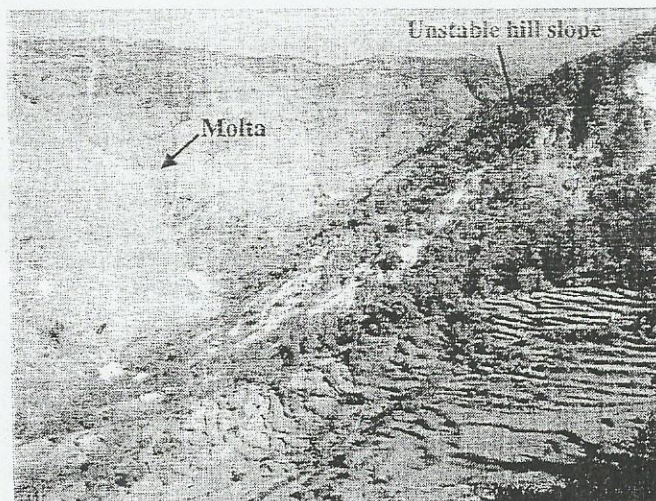
View of hill slope of the Site area having wedge failure

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View of flat ground at village Ganaai CH 5.0 Km



Upstream view of the Site with village Molta in the background

After CH 5.0 (village Ganaai) it was observed that the road alignment passes through the hill slope which is susceptible to mass wasting activities; also in order to reach village Molta the alignment would have to cross river Patal Ganga on the banks of which there is thick deposit of overburden and slope wash material (with no bed rock exposure) which when excavated or disturbed may lead to slope failure. The road alignment passes through a few Nallas/streams some of which are perennial one such nalla (Damgarhi nalla) forms a deep gorge near village Dadmi.

The approximate strength of exposed rock mass is around 50 to 100 MPa and has undergone W_0 to W_3 weathering grade. There are total fourteen hairpin bends throughout the road alignment which are at CH 1.275, 1.550, 2.125, 2.275, 2.925, 3.025, 3.150, 3.300, 3.525, 3.825, 4.025, 4.500, 4.625 and 4.750 Kms respectively. Some of the hairpin bends are as close as 100-200 m to each other; therefore, utmost care has to be taken while constructing them and proper protection/support measures are to be taken while their construction.

The road alignment has 1:20 of rising and falling gradient with 1:40 gradient at the hair pin bends.

- 4- **Seismicity of the area:** According to Indian Standard code the site falls in seismic zone V of seismic zoning Map of India (IS 1893, part 1, 2002) which corresponds to intensity IX and above on MM scale.

On the basis of the geological inspection of the site studies carried and the facts given above, the following recommendations are being made for the construction of the proposed road failing to these recommendations this report will be automatically treated as cancelled.

5- **Recommendations:**

1. Blasting by explosives for the road construction is restricted as geologically the rocks exposed along the alignment corridor are highly susceptible to failure as they are heavily jointed having adverse geometric relationship with the slope. Use of explosives will render the slopes highly unstable.

Photo copy attached.

2. Rock excavation must be carried out by the skilled manual workers as the rock slopes are prone to slide down in case of rapid disturbance.
3. Adequate safety measures at the site must be made with regard to the human safety and the road cutting should be carried out under the guidance of a geologist.
4. The slopes on either sides of entire road must be protected by the construction of suitably designed retaining wall/ breast wall with proper weep holes, 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. Construction of large longitudinal lined drain all along the hill side of the road with adequate provision of cross drains is necessary.
6. The road alignment passes through a few Nallas/streams some of which are perennial one such nalla (Damgarhi nalla) forms a deep gorge near village Dadmi. It is advised to construct bridges over these nallas so as to avoid any damage to the constructed road by rise in stream water level especially during rainy season.
7. Construct the road by half cut and half fill techniques and compact the fill material properly by dynamic compaction.
8. Disposal of muck and excavated waste on the lower slopes of this road is to be strictly avoided; failing to which will increase the weight of the lower slope resulting in the increase in driving forces. It is advised to dispose the muck on the identified site for muck disposal.
9. All the construction activities ought to be carried out as per the standard codes of practice laid by the BIS and MORTH.
- 6- **Conclusion:** On the basis of the geological / geotechnical studies carried at the site and with the above recommendations, the site proposed for 10.0 Km long Patal Ganga-Ganaai-Molta motor road was found geologically suitable for the construction between CH 0.0 to 5.0 Km (till village Ganaai) and further area beyond CH 5.0 Km till village Molta should be re-surveyed for a new road alignment.

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Date: 16/12/2017

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 गोपेश्वर

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photo copy attached.

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