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ROAD ALIGNMENT STUDIES ALONG GILGIT-GUPIS ROAD NORTHERN AREAS PAKISTAN

By

MOHAMMAD LATIF
ARSHAD FAYAZ

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ROAD ALIGNMENT STUDIES ALONG GILGIT-GUPIS ROAD NORTHERN AREAS PAKISTAN

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ABSTRACT

Road alignment and related studies along Gilgit-Gupis roads were carried out during the field season of 1986.

The road which is 110 km long is jeepable in fair weather conditions.

Geological mapping and study of seven bridge sites from the engineerging geological point view was done. The entire road was devided into 20 sectors and a comparative statement showing the material exposed, problems, remedial measures and blasting pattern was prepared. At certain places realignment of road was also proposed.

Proper execution and implementation of recommendation made, may help to great deal in construction of better road and bridges.

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INTRODUCTION

Purpose and Scope

The Ministry of Kashmir Affairs and Northern Affairs is working upon a long term plan to link all parts of the Northern Areas with the Karakoram Highway and extend communication facilties particularly to the remote areas. The Gilgit - Chitral road which is jeepable in fair weather condition now-a-days has been taken up as a part of this development plan and in the first phase of this project Gilgit to Gupis portion, which is about 110 km long, will be widened and metalled.

The Geological Survey of Pakistan studied the present alignment of this road from Gilgit to Gupis for slope stability and other engineering geology problems. This work was carried out in September - October, 1986 and included landslide investigation along the present alignment, foundation studies for bridges, excavation techniques in Pari areas, other related problems and remedial measures for the control and stabilization of slopes.

Method of Investigation

The investigations included demarcation of geological formations in the form of a road log (Fig. 1), prepared a table showing main aspects of different sectors, such as material exposed, problems, remedial measures and designing of suitable blasting patterns for rock excavation. Five sketches of proposed bridge sites were drawn and their foundation material were studied from engineering geology point of view.

At certain places re-alignment of the road to suitable sites were recommended and shown on the map.

Location

The Gilgit-Gupis road falls within the longitudes 74°to 73°27'29" E and latitude 35°55' to 36°13'43" N. It passes through Survey of Pakistan toposheets 43 I/5, I/1, 42 L/4 and 42 H/16, H/11, H/8. It follows the Gilgit river from Gilgit to Gupis (Fig. 1). Gilgit is situated on the Karakoram Highway (KKH), about 612 km from Rawalpindi.

Relief and Topography

The Gilgit river valley trends nearly east-west in this area. This valley widens considerably at certain places such as near Sherot, Golapur, Singal and Gakuch to provide habitation and crop cultivation for the local population. The valley becomes narrower in the area between Gakuch and Gupis.

The topography between Gilgit and Gupis is quite rugged due to high peaks and steep slopes and the relief is moderate to high with elevation difference approximately 950 m between Gilgit and Gupis.

Climate and Vegetation

The climate is almost arid type. The summer is pleasant and the temperature ranges between 30° to 35° C. The winter is very cold.

In Gupis area the winter temperature falls down to below freezing. The strip of Gilgit river valley between Gilgit and Gakuch is lush green. Different types of fruit trees such as mulbury, grapes, apricot, and walnut are grown in this area. People mostly practice agriculture. Wheat and maize are the main crops of the area. The stream water is used for irrigating the valley fields. Natural forests are present at higher altitude on the slopes of mountains in small areas.

REGIONAL GEOLOGY

Rocks exposed along the road from Gilgit to Gupis are metasedimentary plus volcanics of Rakaposhi Volcanic Complex and the intrusive rocks-granite, granodiorite-diorite of Ladakh intrusives. Thick moraine deposits, terrace and river alluvium are quite widespread along the river of Gilgit.

The generalized succession of the area is given below:

River alluvium and terraces	Recent to-Sub Recent
Moraine deposits	Plio-Pleistocene
Ladakh intrusives	Late Cretaceous to Miocene
Rakaposhi Volcanics complex	Lower Cretaceous

Rakaposhi Volcanic Complex

This rock sequence was included in the Greenstone Complex, the term introduced by Ivanac, Traves and King (1956) to the heterogenous and multi-lithological assemblage of rock with predominant greenish coloration in metasedimentary rocks mixed with large group of volcanic rocks, extending from Hindu Kush in the west to Baltistan in the east. Later on Tahirkheli (1982) assigned it the new terminology as "Rakaposhi Volcanic Complex" which originated as a thick oceanic crust formed in the Tethys, between the Converging 'Indo-Pakistan and Eurasian Plates. It is developed mostly on the northern periphery of the Kohistan Island arc. Rocks of Rakaposhi volcanic complex are mostly exposed along the road from Gilgit to Gupis. At many places this formation is intruded by diorite, granodiorite and granite of Ladakh intrusives. Lithology of Rakaposhi volcanic complex slightly varied from place to place.

In Henzal area, which is about 11 km from Gilgit, Rakaposhi volcanic complex is composed of quartzite, phyllite, intruded by epidotized and uralitized basalt. The quartzite and phyllite are thin bedded and well jointed. Joints are closed and tight. All the rocks are fine grained. In thin section the quartzite consists of a mosaic of quartz and plagioclase with lesser amounts of hornblende and trace amounts of actinolite and garnet. All the quartz is strained and many quartz grains have penetrated the plagioclase grains during recrystallization.

Thin bedded quartz biotite schist is exposed opposite Sher Quilla area (Fig. 1). It is intruded by diorite. The diorite is massive, compact and hard. It is medium grained, consists of orthoclase, hornblende biotite with some grains of quartz. It is highly jointed and fractured. Joints are open and filled with secondary material. Malachite, staining has been noticed at many places in this area. Quartz veins are also common.

The exposed rocks are quartz biotite schist, quartzite with layered andesite and basalt in the area between Dalnati gah and Singal village along the road (Fig. 1). These rocks are thin to medium bedded having no definite trend due to structural disturbance. Dolerite dykes of 10 cm to 75 cm thick intersected these rocks profusely. The schists consist primarily of biotite and quartz and contain many streaks and irregular patches of quartzite. Basalt is compact, hard, massive, shows porphyritic texture and hornblende crystals are found as phenocrysts. Four sets of joint are observed, joints are close and tight. Slicken side is very common feature in this area. Malachite staining is also common in thin to thick bedded porphyritic andesite. A small sulphide zone is present in Zard Pari area which is about 700 m in length along the road.

Porphyritic basalt is exposed in the area of Iskhuman suspension bridge about 2 km short of Gakuch. The salt is massive, compact and hard. Hornblende and pyroxene crystals are found as pheno-crysts.

Thin bedded quartzite is exposed in Damas Pari (Fig. 1) which is intruded by diorite and dolerite. Quartzite shows no definite trend due to intensive magmatic activity. Diorite is medium grain and composed of feldspar, biotite, hornblende with some quartz.

In Jandoli Pari (Fig. 1) area rocks exposed are impure quartzite, slates, phyllitic schist and semi to medium crystalline limestone. They occur in thin isolated pockets. Acidic intrusion intruded the metasediments which also distrubed the trend of these metasediments. Three sets of joints are present in these rocks. Joints are close and tight. White and coarse grained marble with greenish grey andesite is exposed in the area of Roshan Gah suspension bridge. Calcite and epidote are found along joint plane as secondary minerals. Two sets of joints are found in these rocks.

Ladakh Intrusives

Ladakh Granodiorite of Ivanac et. al (1956) and Bakr (1975) Kailas Granodiorite after the Granodiorite of the Kailas Range west of Gilgit had been named as "Ladakh-Kohistan granitic-belt" by Jan et. al (1981) which extend from Dir in the west to the Ladakh range in the east. Later on, Tahirkheli (1982) renamed all these intrusive rocks ranging from felsic to mafic in composition as the "Ladakh Intrusive" belonging to multi cycle magmatic phases. Jan et. al (1981) assigned Late Cretaceous to Miocene to all the Si-saturated intrusive rocks.

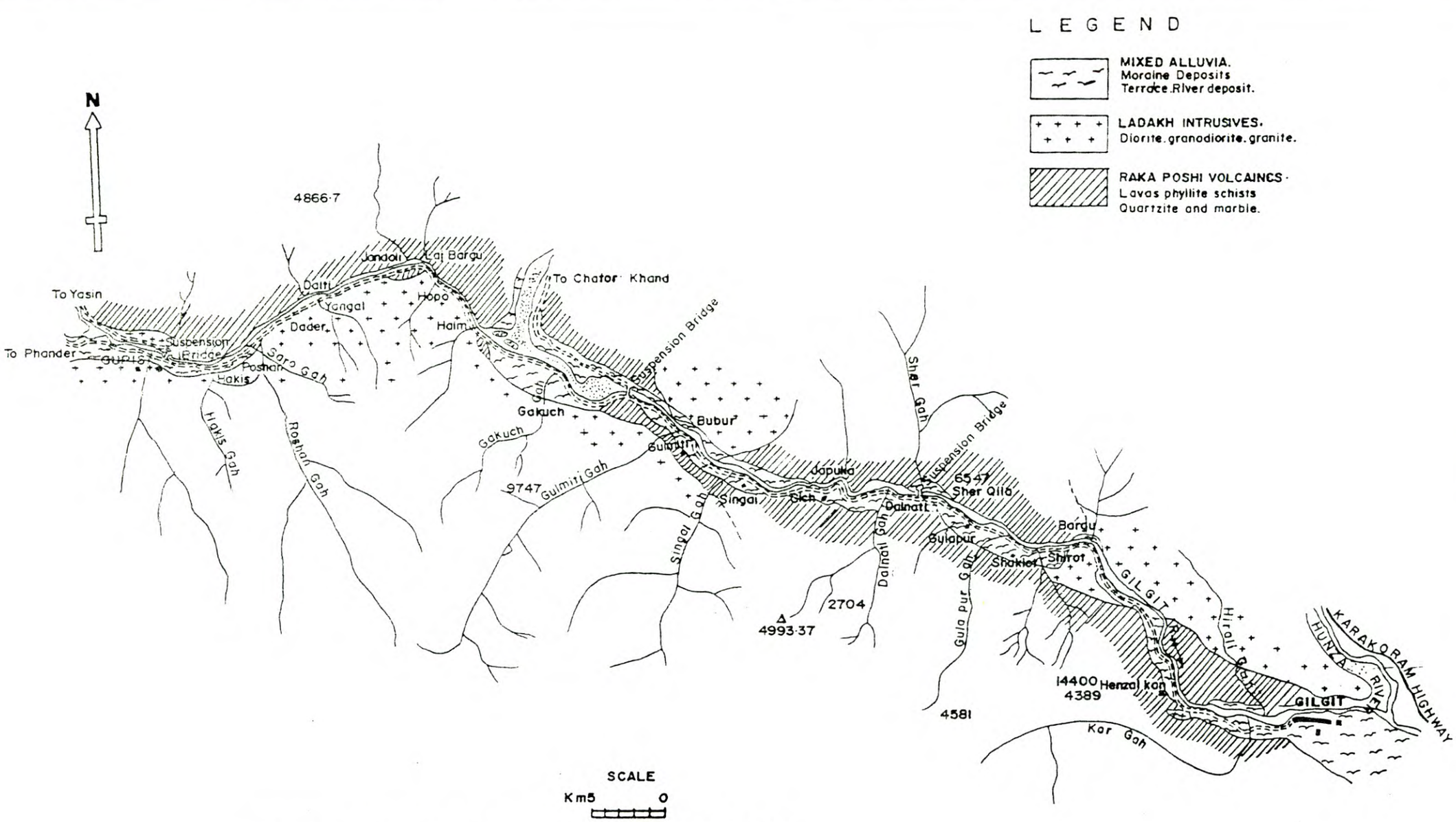

FIGURE. I. GEOLOGY ALONG THE GILGIT___ GUPIS ROAD.

Rocks of Ladakh intrusives intruded the Rakaposhi Volcanic Complex at many places between Gilgit and Gupis. First exposure is near Gilgit about 8 km in the west along Gilgit river. Here two types of acidic rocks are found, one is more mafic than other. One is biotite granodiorite and other one is hornblende granodiorite. Both the intrusions are medium grained, equigranular, hard and compact. Two sets of joints have been noticed.

Three phases of magmatism have been observed along the road opposite **Bargo** village (Fig. 1). The oldest intrusion is quartz diorite and middle is coarse grained granodiorite and the younger one is granitic in composition. Dolerite dykes, small quartz veins and a few pegmatite veins also intersected these acidic intrusions. Xenolith of quartz-mica schist are also found. Diorite is medium grained composed of feldspar, biotite, hornblende with some quartz. Hornblende granodiorite is coarse grained and found in the form of small stocks. It has sharp contact with other two intrusions. Granite is medium grained composed of quartz, feldspar and biotite. All the rocks are equigranular and show hypidiomorphic texture. The rocks of this area is highly jointed, fractured and faulted. A number of shear zones have been noticed. Joints are tight and widely spread.

In the area between Gakuch and Gupis intrusive rocks exposed are granite and orbicular diorite with dolerite dykes and devoid of pegmatite veins. Mafic content varied in dioritie at different places, for example at Dalti Pari (Fig. 1) mafic content is low as compared to Hoper area where amount of hornblende has been increased. Joints are mostly open and filled with secondary material.

Quarternary Deposits

In Gilgit river valley from Gilgit to Gupis most of the area is covered by Quarternary deposits such as moraine deposits, terraces and river alluvium.

Moraine deposits

Moraine deposits are found at certain places along Gilgit-Gupis road such as one km ahead of Henzal village, Goherabad, Dalnati village, near the suspension bridge of Singal gah, Gulmati area, about 1 km short of Gakuch surrounding Roshan village and between Hakis and Gupis (Fig. 1). These moraine deposits are mostly unconsolidated type. They are commonly light grey to rusty brown in colour, slightly cemented by silt and clay. They are composed of particles of nearly all the dimension viz. clay to boulder size. The thickness at places in the valley varies from 30 to 75 metres.

Terrace deposits

Terrace deposits mostly consist of loose, unsorted debris. The material having boulder and blocks of country rock ranging upto 1-1/2 metre diametre. The terraces are the result of debris flow from the high altitude due to steep slopes and heavy overburden. The terraces are sometime wider and sometime narrow according to valleys structure. The terraces having different thickness ranging from 50-100 metres and mostly cut by streams and rivers. Nearly all the villages along the road are situated on terraces for example Henzal Kan Sherot, Gakuch, Roshan, Haim and Hoper. The

terraces are mostly used for cultivation and growing of fruit trees between Gakuch and Gupis.

River alluvium

River alluvium are quite common between Gilgit and Gakuch in the Gilgit river valley. River alluvium are composed of silt, sand, gravel to boulders, loose to semi consolidated. At some places bedding of different type of materials are prominent for example in the area betwen Golapur and Sher Quilla suspension Bridge. In this area loose sand and gravel are interbedded. The deposition often took place due to the damming of river on different occasion by glacier moraines and sliding of debris lying on the slope of nearly vertical mountains. These deposits are seen at different levels and show at least more than one chance of such happening. These deposits are found near Gilgit city, near Bargu Pari, Henzal Kan area, Golapur, Singal and Gakuch.

BRIDGE SITE INVESTIGATIONS

7 bridge site investigations are made between Gilgit and Gupis along Gilgit-Gupis Road. Presently wooden suspension bridges exist at almost all the places, which are jeepable. For the future requirement of the metalled road and keeping in view the proposed alignment for the new road, bridge site investigations are carried out. Comparison is also made in case more than one bridge site is considered alongwith the existing bridge site. Emphasis is given to the type of rocks material exposed at the abutments and where the necessary schematic geological cross-sections are also prepared. An attempt is also made to describe the availability of the construction material for the proposed bridge site which will be helpful during the course of the construction of the bridge.

Roshan Gah Bridge Site

Roshan Gah Bridge Site is located on the Gilgit Gupis Road about 7.1 km short of Gupis. The bridge site (36 13 8 N, 73 30 51 E) lies in the Survey of Pakistan topographic sheet No.42 H/12 (Fig. 2).

A suspension bridge has already been built at the site. Roshan Gah(Nullah) has a big catchment area with perennial flow. Andesitic rocks are exposed on both the abutments of the existing bridge. It is compact, hard and massive and greenish grey to brownish grey on weathered surface and dark grey on fresh surface. Two sets of joints (i) N 40 W, 70 NE and (ii) N 30 E, 80 SE are also present. Calcite and epidote are present as secondary minerals.

An alternate site is proposed at about 20 metre upstream of the existing site for the construction of a permanent bridge. At this site hard

1- Roshan Gah Bridge site.
2- Saro Gah Bridge site.
3- Haim Gah Bridge site.
4- Gulmiti Gah Bridge site.
5- Singal Gah Bridge site.
6- Dalnati Gah Bridge site.
7- Gulapur Gah Bridge site.

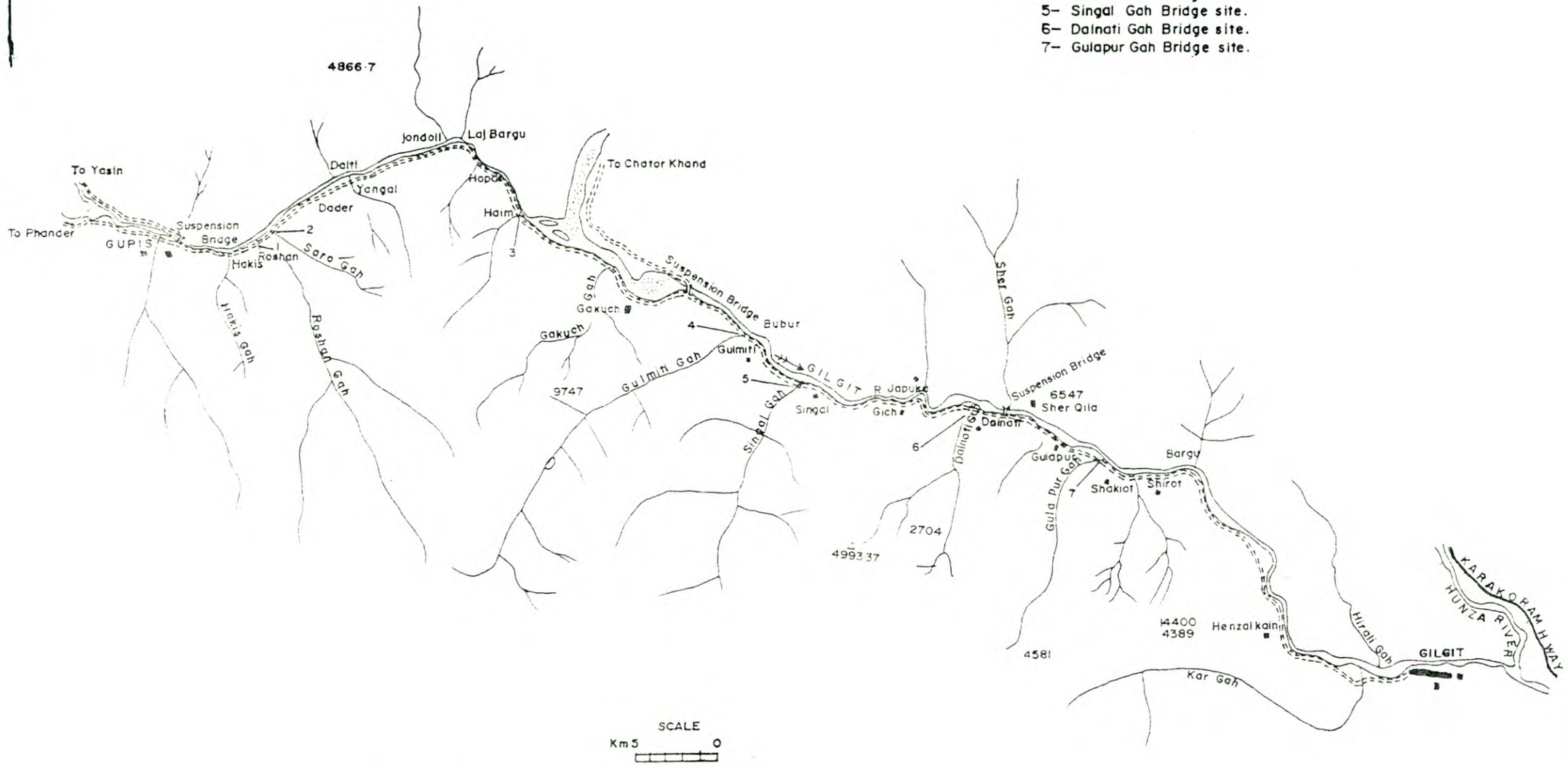

Fig:2 Map showing locations of Bridge sites along Gupis_Gilgit Road.

marble bands with intrusion of andesitic sills are exposed on both the abutments (Fig. 3). This site is proposed in view of the following advantages:-

1. The approach to the bridge will be straightened.
2. The soundness and foundation conditions of the abutment rocks are better.
3. The deck level of the bridge will be higher than the existing bridge. It would allow more debris material to pass through without endangering the abutments. For this purpose an arch bridge is proposed at this site.

In case of selection of the proposed site for permanent bridge the proximity of the graveyard on the left abutment may pose some problem in the widening of the road. The required width will have to be achieved by rock excavation on the left abutment site in this case.

Construction material for the proposed bridge is also available in the nullah bed; which mostly consists of diorite and granodiorite boulders. Sand is also available on the banks of the Gilgit River.

Saro Gah Bridge Site

Saro Gah is located 7.6 km short of Gupis on Gilgit-Gupis road. The bridge site (36 13 33 N, 73 31 42 E) lies in the Survey of Pakistan topographic sheet No. 42 H/12 (Fig. 2).

A small wooden bridge which is 6 metre long exists at this site. The abutments of the present bridge rest on masonry structure made of boulders

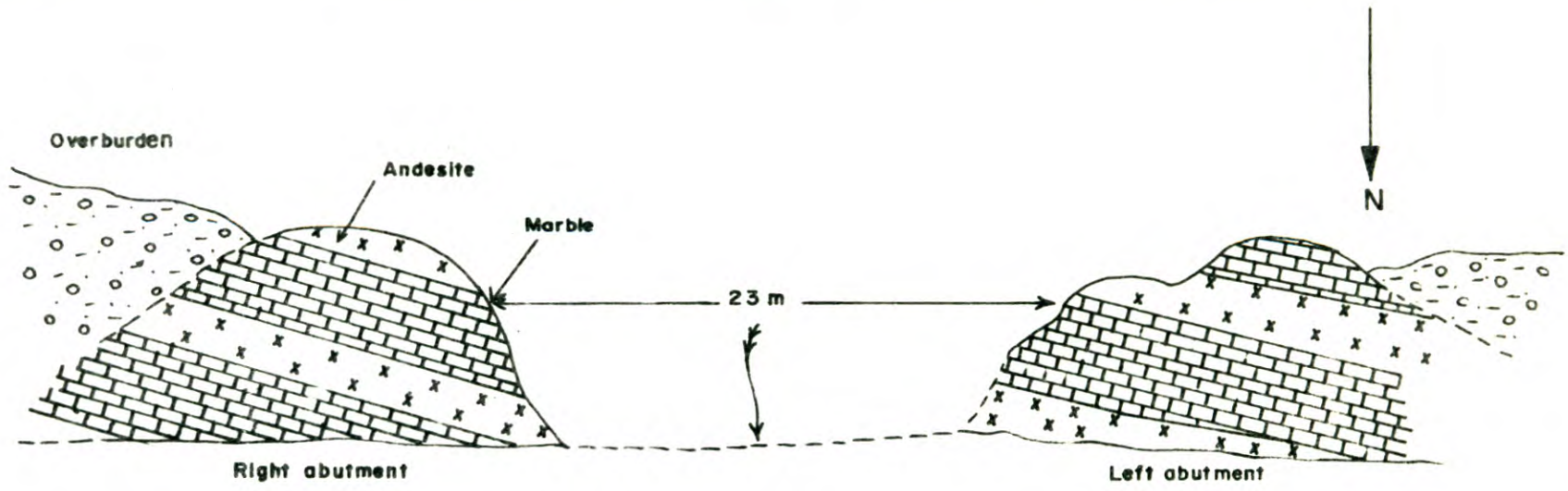

Fig 3: Schematic geological section across the proposed site of Roshan gah Bridge.

which are not well compacted and packed. No bedrock is available in the vicinity of the site and loose gravels and pebbles of stream bed deposits are present on both the abutments of the road. The nullah has a seasonal flow.

An R.C.C. bridge with a span of 6 metre is recommended. As no bedrock is available the foundation of the bridge should rest on spread footing and be taken below the scouring depth of the flood water.

Construction material is available in the nullah bed and sand can be brought from the banks of Gilgit River.

Haim Gah Bridge Site

Haim Gah Bridge Site is located at about 28.3 km short of Gupis on Gilgit-Gupis Road. The bridge site (36 45 N, 73 41 56 E) lies in the Survey of Pakistan topographic sheet No. 42 H/12 Fig. 2).

A wooden suspension bridge has already been constructed on the Haim Gah but the traffic also passes through the nullah bed in fair weather.

The present bridge shows outcrop of granite on the right flank which is highly weathered. No bedrock is exposed on the left abutment side and the foundation of the bridge on left abutment is exposed to the danger of collapsing due to attrition and scouring during the high flood season. In view of this, an alternate site is proposed for the construction of a permanent bridge.

The alternate site is located about 500 m upstream of the present bridge. Granite is exposed on both the flanks of the nullah which can form a good abutment rock and can support the foundation (Fig. 4). The span of the bridge will also be reduced at this site and will suite the alignment of the road.

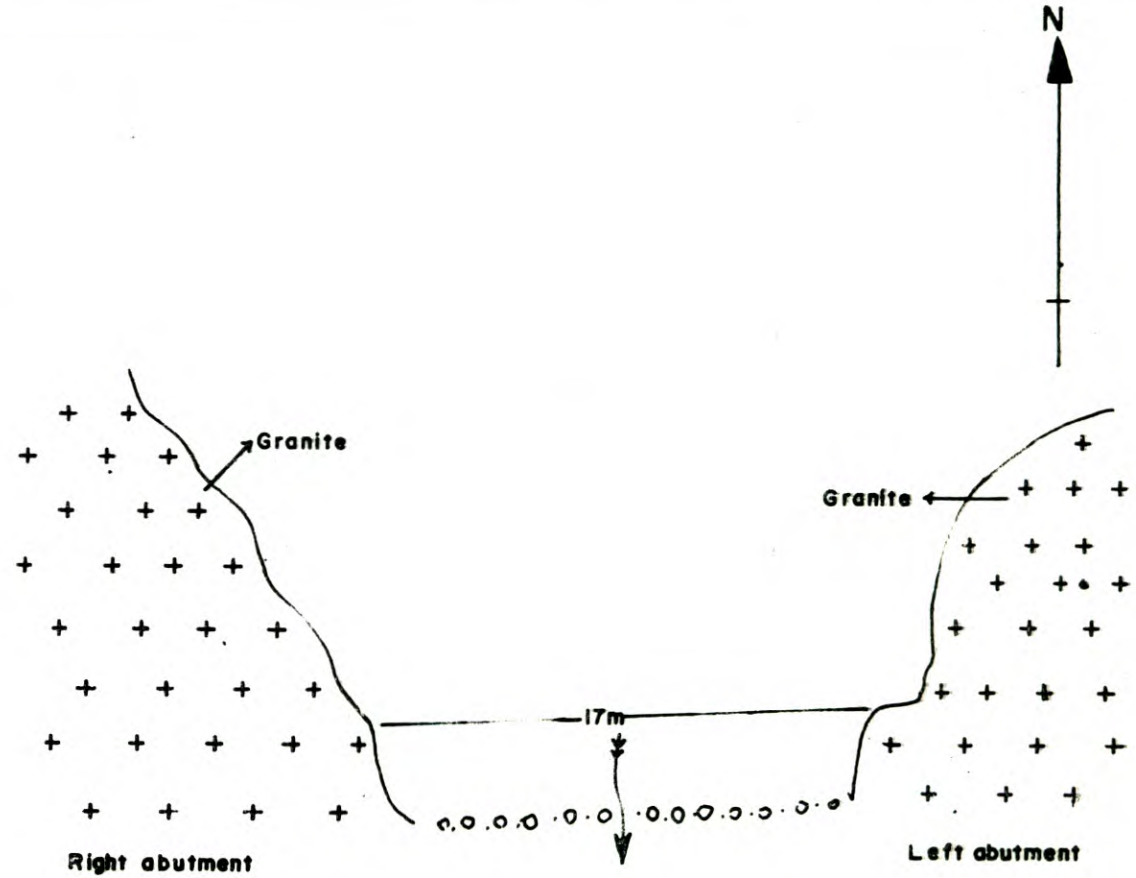

Fig.4: Schematic geological section across Haim Gah bridge site.

Gulmiti Gah Bridge Site

Gulmiti Gah Bridge Site is located 49.1. km short of Gupis and 60.9 km from Gilgit on Gilgit Gupis Road. The bridge site (36 8 47 N, 73 51 31 E) lies in the Survey of Pakistan topographic sheet No. 42 H/16 (Fig. 2).

At present a wooden bridge with a span of 12 metre exists at this place. This bridge is not strong enough to allow heavy traffic to pass over it. Therefore, a concrete bridge structure with same span of 12 metre is recommended at this site. As no bedrock is available so the bridge foundation will have to be placed on the river bed deposits. There is no change of material or difference of span upstream or down stream of the site. Therefore the same site is recommended for a permanent bridge. Construction material for the proposed concrete bridge is available in the nullah bed.

Singal Gah Bridge Site

Singal Gah Bridge Site is located 54.2 km short of Gupis and 55.6 km from Gilgit on Gilgit Gupis Road. The bridge site (36 7 14 N, 73 53 30E) lies in the Survey of Pakistan topographic sheet No. 42 H/16 (Fig. 2).

At present a wooden suspension bridge with a span of 100 metre exists on this nullah. The abutments of this bridge rest on stone masonry structures as no bedrock is available within a reasonable depth at this site. The nullah has a perennial flow which increases considerably during the snow melting season. The bridge abutments are exposed to the risk of collapsing due to strong water currents and deep scouring effects during the high floods. The present bridge site is, therefore, not suitable for a permanent bridge.

Bedrocks consisting of andesite and basalt are exposed about 1000 metre upstream of the existing bridge, but it involves a detour from the present road alignment in addition to increase in gradient. However, 300 metre downstream of the existing bridge, the span of the nullah decreases considerably (Fig. 5). Which can be further reduced by construction of spurs. As no bedrock is available for the foundation within a reasonable depth the abutments should rest on spread footing with pitched stone masonry work. The foundation should be placed deeper than the scouring depth of water in the nullah bed. This site will also help in straightening the alignment of the road.

Dalnati Gah Bridge Site

Dalnati Gah Bridge Site is located 12.1 km short of Singal and about 43.5 km from Gilgit on Gilgit-Gupis Road. The bridge site (30 5 14 N, 74 0 20E) lies in the Survey of Pakistan topographic sheet No.42 L/4(Fig. 2).

A wooden suspension bridge is already present on this nullah, which is in poor condition and loaded vehicles cannot pass on the bridge. The loading and unloading of the goods create hinderance in the smooth flow of traffic. Dalnati is a big nullah with large catchment area. It has considerable flow throughout the year. Before joining the Gilgit river, the course of Dalnati Gah becomes very wide and has developed big flood plain areas on both the sides. Therefore, a new concrete bridge should be constructed to cross the Dalnati Gah. Keeping in view the poor condition of the present bridge, and 4 km distance which is required to reach the bridge a new site is proposed 4 km downstream of the present bridge. This will reduce the distance, and will improve the alignment. River bed deposits consisting of silt, sand and boulders are exposed on both the abutment sites. However, the span of the bridge on this site will be larger

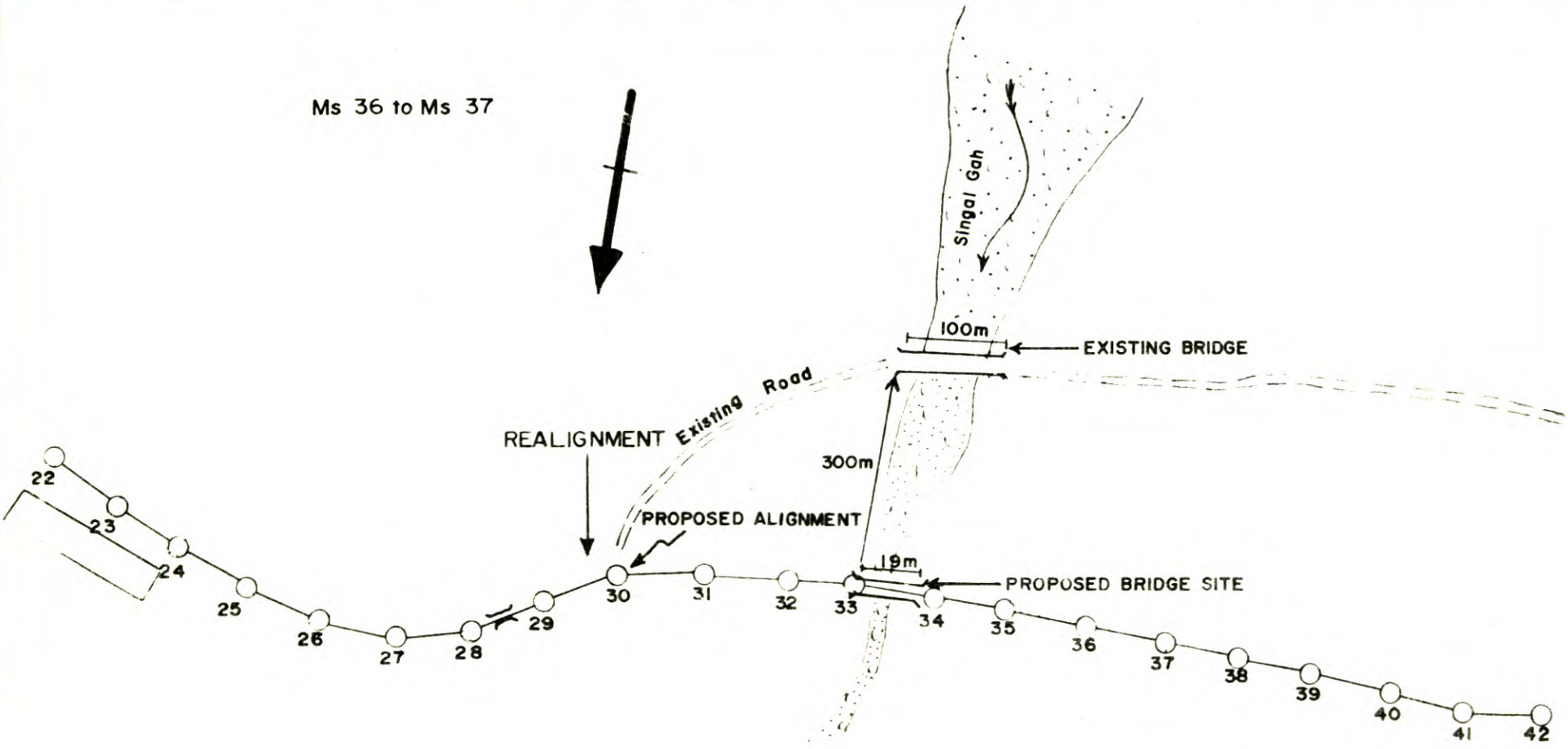

Fig 5: Proposed bridge site and road alignment across the Singal Gah.

than the existing bridge. For reducing the span of the nullah embankments should be constructed on both the sides of the nullah. These embankments should be supported by 2 or 3 spurs upstream of the proposed bridge site to control the water currents during the high flood season.

Gulapur Gah Bridge Site

Gulapur Gah Bridge Site is located 22.4 km short of Singal and about 33.2 km from Gilgit on Gilgit-Gupis Road. The bridge site (36 3 9 N 74 6 E) lies in the Survey of Pakistan topographic sheet No. 42 L/4 (Fig. 2).

Presently the road passes through the River alluvium deposits of Gulapur Gah. The nullah has seasonal flow of water. The nullah bed is wide,flat, and do not bring huge amount of water and debris during the rainy season, causeway is therefore, recommended at this site.

Table 1: Main aspects of different sectors of the road between Gupis and Gilgit.

****

S.No.	Road Strip	Length	Material exposed	Slope angle	Problems encountered	Remedial measures
1.	2.	3.	4.	5.	6.	7.

1.	Gupis-Hakas gah	4 km	Morains, and alluvial soil.	Steep and cliff forming to gentle	(i) Steep angle of repose.
					(ii) Hanging erratic boulders
					(iii) Road gradient is steep at a few places.
						For (i) and (ii)
						1. Trimming by controlled blasting.
						For (iii)
						Cut and fill technique.

2.	Hakas-Roshan	2 km	Cultivated fields.	Terraced fields	(i) Steep road gradient near Roshan gah.	1. Bench blasting.

3.	Roshan gah-Soro gah	3 km	Morains with big embedded boulders.	Steep and cliff forming.	(i) Sliding due to seepage
					(ii) Narrow road width
					(iii) Road gradient above normal.
						For (i)
						1. Construction of check-wate drain.
						2. Smoothening of slope by blasting.
						For (ii)
						1. Widening by dozer
						For (iii)
						1. Cut and fill method.

1.	2.	3.	4.	5.	6.	7.

4.	Sarogah-Dalti gah	4.4 km	Terrace deposits comprising silt, pebbles & boulders loosely cemented	Slope upto 45°	(i) Narrow road width
					(ii) Steep gradient
						For (i)
						1. Excavation by dozer.
						2. Boulder blasting.
						3. Drilling and blasting by presplitti method.
						4. Retaining & Gabion wall.
						For (ii)
						1. By cut and fill method.

	Dalti Pari	100 km	Granite & grano-diorite.			
5.	Dalti Pari-Yangal gah	3 km	Terrace deposits River bed deposits	Steep	(i) Steep angle (ii) High gradient	For (i) 1. Realignment proposed towards the river side. 2. Smoothening of gradient by cut and fill method.

6.	Yangal gah-Jandoli Pari	5 km	River alluvium, Terrace deposits, Quartzite, slates & limestone	Steep	(i) Steep gradient
					(ii) Narrow width
						For (i)
						1. Cut & fill method with dozer.
						For (ii)
						1. Lowering down the present road level by Bench blasting.

7.	Jandoli Pari-Bargu gah	2.3 km	Terrace deposits
			River bed deposits.
				Almost vertical with inter-bedded gentler slopes.	(i) Road gradient very steep and beyond the specification.
					(ii) Big erratic boulders.
						For (i)
						1. Realignment towards river side proposed.
						2. Smoothening by cut & fill method
						For (ii)
						1. Boulder Blasting.

2.	3.	4.	5.	6.	7.
8. Bargu gah-Hopar gah	3.3 km	(i) Terrace deposits (ii) 300 m long Hopar Pari consists of dioritic rocks.		(i) Narrow road width. (ii) Steep gradient	For (i) & (ii) 1. Lower down the road by excavation manually and by bench blasting and drilling method.
9. Hopar gah-Haim gah	2.5 km	(i) Cultivated lands (ii) 100 m length of dioritic rocks.	Normal	(i) Boulders will be encountered in the realignment portion towards the river side.	For (i) 1. Realignment towards river side proposed. 2. Excavation by boulder blasting. 3. Smoothening of gradient by cut and fill method.

10. Haim gah-Gakutch	3.5 km	(i) River alluvium
		(ii) Diorite and Quartzite.
				(i) Narrow width.
				(ii) Undercutting of the river.
					For (i)
					1. Realignment proposed towards river side.
					2. Cut and fill method.
					For (ii)
					1. Lowering down the present road level by bench blasting.

11. Gakutch-Askuman bridge Gakutch Pari	5.1 km 700 m	(i) Terrace deposits (ii) River bed deposits (iii) Porphyritic basalt.	Normal	(i) Boulders will be encountered. (ii) Sharp road turns. (iii) Steep gradient (iv) Widening of the road.	For (i) 1. Cut and fill method by dozers. 2. Excavation by dozer and boulder blasting technique 3. Smoothening of gradient by cut & fill method. Safeguarding the turns with realignment.

1.	2.	3.	4.	5.	6	7

						For (ii)
						1. Widening of sharp turns by rock excavation through controlled blasting.
						2. Realignment proposed in some portions.
						
						For (iii) & (iv)
						1. Cut and fill method.
						2. Bench blasting technique.
						3. Breast walls towards the river side.

12.	Askuman bridge to Gulmiti gah	5 km	River bed deposits. 1 km
			Moraine deposits 3 km
				Vertical & cliff forming	(i) Mud flow problem.
					(ii) Narrow road width.
					(iii) Insufficient lateral/ toe support.
						For (i)
						1. 2-3 cause-way proposed for major mud flow zone.
						
						For (ii)
						1. Widening by controlled blasting.
						
						For (iii)
						1. Toe walls at suitable locations proposed.

13.	Gulmiti gah- Singal gah	5 km	Cultivated lands	Normal	Realignment proposed in this whole strip towards river side.	

1.	2.	3.	4.	5.	6.	7.
14.	Singal gah Dalnati gah	10 Km	(i) Cultivated lands 5 km	Gentle	(i) Compensation of trees, lands & property involved.	For (i) 1. Realignment proposed towards the river side.
			(ii) River bed deposits 1 km (hard, compact, very well cemented)	"	(ii) Smoothening of gradient and widening of the road required.	For (ii) 1. Lowering down the road level by cut & fill method. 2. Bench blasting for rocky portions. Lowering the road by cut and fill method.
			(iii) Terrace deposits mostly debris 600 m alongwith 6 out crops of rock ranging in thickness from 15 to 20 m.	"		
	Gich Pari	100 m	(iv) Quartzite, Basalt, andesite.			
	Zard Pari	2 km	(v) Schists, Quartzite and dolerite dykes.			
	Goherabad by Pass-		(vi) Grandiorite	Steep	(i) Steep and poor gradient.	For (i) 1. Realignment proposed towards the river, it will increase distance but improve gradient cut& fill method.
			(vii) Moraine deposits-2 km some patches of schists.		(ii) Loose scree.	

1.	2.	3.	4.	5.	6.	7.

15.	Dalnati gah-Sher Qila bridge	3 km	Plain area- 2.7 km
			Moraine deposits -300 m
				Gentle
				High ridges
					(i) Widening of the road.
					(ii) Boulders will be encountered.
					(iii) Widening of the road.
						For (i) & (ii)
						1. Excavation by dozer for widening of the road and smoothening of gradient by cut and fill method.
						2. Boulder blasting.
						For (iii)
						1. This area requires widening at double size of the proposed road to provide space for debris.
						2. Retaining and breast walls are also proposed.

16.	Sher Qila Pari-Gula Pur Rest House Sher Qila Pari	5 km
		200 m
			(i) River bed deposits
			(ii) Cultivated lands
			(iii) Diorite and Quartz, mica schist.
				Poor	(i) Widening of the road.
					(ii) Poor gradient
						For (i)
						1. With the help of dozer.
						2. Retaining & parapett walls.
						For (ii)
						1. Cut and fill method.
						2. Scalling with steel bars.
						3. Rock bolting at selected places.
						4. Bench blasting.

1.	2.	3.	4.	5.	6.	7.

17.	Gulapur Rest House-Sherot Pari
	
	Sherot Pari
		5.2 km
		
		600 m
			(i) Cultivated lands
			(ii) Fluvioglacial deposits
			(iii) Granite-grano-diorite with dolerite dykes.
				Normal	(i) Widening of the road.
					(ii) Compensation to the locals.
					(iii) Gradient is steeper.
						For (i)
						1. With the help of dozer.
						For (ii)
						Realignment proposed.
						For (iii)
						1. Cut and fill method.
						2. Half tunnel.

18.	Sherot Pari-Bargu Pari.	2.5 km	(i) Fluvioglacial deposits.	Normal	(i) Widening of the road.	For (i) 1. By making parapett and retaining walls. 2. Boulder blasting is recommende

19.	Bargu Pari-Henzel	7.7 km	Fluvioglacial deposits.	Normal	(i) Widening of the road.
					(ii) Boulders.
					(iii) Gradient.
						For (i) and (ii)
						1. With the help of dozer.
						2. Retaining&parapett walls.
						For (iii)
						Cut and fill method.

20.	Henzel-Gilgit	14.3 km	Cultivated lands on both sides.	Normal	(i) Widening of the road.
					(ii) Compensation to the built houses and fruit trees.
						For (i)
						1. With the help of dozer.
						For (ii)
						Realignment proposed.

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