(FIELD SEASON 1985-86)

A REPORT ON THE PRE-CONSTRUCTION STAGE GEOLOGICAL INVESTIGATIONS OF THE JAMRANI DAM PROJECT, RIVER GOLA, DISTRICT NAINITAL, UTTAR PRADESH.

(With Seven Plates)

By
R. Anbalagan
Geological Survey of India.
(May'1987).

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A B S T R A C T

The Jamrani dam project envisages the construction of a 130 m. high dam across river Gola, mainly for irrigation purposes in Bhabar area of Nainital district and generation of 20 MW of power. Lower Siwalik rocks, comprising sandstone interbedded with claystone and siltstone occur at the site. The main Boundary fault, separating the rocks of Lower Siwalik from those of the Lesser Himalaya is the principal structural discontinuity in the area. It traverses river Gola about 3.5 km. upstream of the dam axis, i.e., within the reservoir area. An inclined hole has been drilled across the thrust zone to study the permeability of the same. Preliminary test grouting has been conducted in the dam foundation area, to study the groutability characters of the foundation rocks. The availability of construction material and the seismicity of the project area are discussed in the report.

I. : INTRODUCTION :

1. The Jamrani dam project envisages the construction of a 130 m. high dam on river Gola near Jamrani village (29°16'0"; 79°36'36"; 53 O/11), in Nainital district, U.P. It is located about 20 km. from Mathgodam 5 km. short of Hairakhan. On completion, theproject would provide irrigation benefits to an additional area of 64,500 hectares of land in Bhabar area of Nainital district. The gross

storage capacity of the reservoir proposed to be impounded is 201 million cubic metre. There is also provision for generation of 20 MW of power in the power house, contemplated near the toe of the dam.

2. The Bhabar area of Nainital district does not have enough ground water potentiality and is almost wholly dependent on the discharge of Gola river for its domestic and industrial needs, in addition to irrigation requirements. But, the discharge of Gola river varies widely from 2 cumec to 100 cumec. It has been estimated that the lean season discharge is barely sufficient to meet the present domestic and industrial requirements of the area. The growth of population and the industrial development envisaged in the area, call for augmentation of the available water resources. As such, the Jamrani dam may be the basic answer for the future developmental activities of the area.

3. Earlier the Planning Commission had approved the construction of a rock-filldam with an upstream concrete membrane at the proposed Jamrani site. But, the Board of Consultants for the project had, in October, 1984, favoured a concrete dam, if feasible, a roller compacted structure at the site after carrying out trial placement tests.

4. The geological investigations of the Jamrani dam project are in progress since 1973. A list of the earlier unpublished reports on the project by the Geological Survey of India and selected references on geological studies conducted in the area are furnished in Appendix-I, which may be consulted for a complete account of its evolution and details of geology.

5. During the field season 1985-86 the geological investigations of the project were continued at the request of the Superintending Engineer, Jamrani Dam Construction Circle, Kathgodam and in pursuance of item No. EG/530/NR/UP/73/73 of the approved field season programme of the Geological Survey of India. During the period under report, the author devoted 271 days for field work at different sites of the project. The field work accomplished during the period comprised the following items:-

	Nature of work :	Quantum of work.
(i)	Detailed geological mapping of the area around the dam site on 1:1000 scale.	0.18 sq.km.
(ii)	3-dimensional logging of exploratory drifts at the quarry site on 1:100 scale.	33.5 m.
(iii)	Detailed geological logging of drill holes.	105.5 m.
(iv)	Geological mapping of the area around the project site.	80 sq.km.

6. The river Gola at the dam site flows in a westerly direction and the dam axis is aligned nearly North-south. The width of the valley at the top of the dam is about 427 m. of which 69 m. lies above the river bed, 217 m. on the left bank and 141 m. on the right bank. The cord-height ratio of the proposed dam is 3.30.

7. The geological investigation were carried out and the writing up of this report has been accomplished under the guidance of Shri G. Pant, Director, Engineering Geology Division-3, Geological Survey of India, Lucknow.

II. REGIONAL GEOLOGY :

8. The regional geology of the area has been studied by various workers. Middlemiss (1890) was among the first to study the granite of Ranibagh area, now known as Amritpur Granite. Heim and Gansser (1939) correlated quartzites and the associated green volcanics of the Bhimtal with the Nagthats of Simla area. Nautiyal (1955)believed that the granite exposed to the north of main Boundary fault is a tectonically transported body thrust over the Siwalik and designated it as Amritpur granite. He also felt that the quartzites occurring in the Bhimtal area are probably equivalent to the Nagthat series.

9. Raina and Dungrakoti (1966) reported that considerable amount of argillaceous matter, fragmentary pieces and pellets of clay occur within the Siwaliks. They also reported xenoliths of Bhimtal quartzite and basic rocks within the Amritpur granite. According to them, the Amritpur Granite outcrop is fringed on the north by a porphyritic rock, which farther towards north splits into two-one running nearly Westwards, fringing the Amritpur granite and found upto Amritpur, while the other goes around the Bhimtal quartzite - trap exposure and is well developed near Ramgarh. They designated the rocks, comprising quartzites, traps, phyllite slates and lenticular bands of limestone and occurring between the two occurrences of porphyries, mentioned above as Bhimtal formation. They felt that the rocks of Bhimtal formation are probably equivalent to Nagthat formation.

10. Misra (1980) felt that the Amritpur granite, sandwitched between the Siwalik and the Nagthat, is a part of Ramgarh group, representing the inverted limb of the Debguru porphyroid.

11. Valdiya (1984) felt that the Amritpur Granite and Nagthats are separated by thrust which he designate

as the Salari thrust. The author prefers to keep Amritpur granite as a separate unit and suggests the following tectonic succession of the Gola valley (After Misra 1980).

Tectonic Succession of Gola valley

Almora Nappe

.....South Almora Thrust.....

Ramgarh Nappe

..... Ramgarh Thrust .....

Krol Nappe(Nagthat formation)

.....Salari Thrust.....

Amritpur Granite

.....Main Boundary Fault.....

Siwalik(Autochthonous)

12. The lower Siwalik, on which the Jamrani dam is located, is truncated towards north by the Main Boundary fault and is bound by the Bhabar talus fans towards south. The Lower Siwalik comprises thick sandstone, interbedded with claystone and siltstone. The brownish-grey to greenish Lower Siwalik sandstones are fine to coarse grained, micaceous and moderately hard. The NW-SE trending Lower Siwalik rocks dip consistantly at moderate angles (35°-55°)towards NE (Plate-I).

13. The WNW-ESE trending Main Boundary Fault dip at steep angles towards ENE. In the reservoir area, the thrust contact passes south of Sakula and Pastola village on the right bank. Then it traverses the Gola river near Panota village, about 3.5 km. upstream of the dam site. On the left bank, it passes south of Hairkhan village and then enters the Lugar stream, near Lugar village, close to the maximum reservoir level. The thrust is generally concealed

under the debris cover. On the left bank of the Lugar stream, the Lower Siwalik rocks exposed close to the thrust, show shearing and dragging effects.

14. The generally greyish, medium to coarse-grained Amritpur granite, locally grading into quartz-porphyry occurs to the north of the Main Boundary fault. The general foliation dips of the granite is 30°-40° towards NNE to NE. Therocks are also traversed by closely spaced joints. The cones of loose debris observed in the river bed, close to the right bank near Pastola village, as well as in the river bed reaches of Bhuria area, consist of small fragments of Amritpur granite mixed with fine grained material.

15. The Amritpur granite and porphyry towards north separated from the Nagthat by the Salari thrust which is discernible near Pokhripheri, Amdaun, Pinsela and Kotjwa. The rocks of Nagthat formation (Bhimtal formation of Raina and Dungrakoti-1966), comprise basalts, amphibolites, phyllites, slates and white purple and green quartzites.

16. The Ramgarh thrust separates the Nagthats/ occurring on the south and the rocks of Ramgarh group on the north. The Ramgarh group consists of porphyritic granite, augen gneiss and pink and green coloured scricite-chlorite schist. Thrust over the Ramgarh group of rocks with the intervention of south Almora thrust rocks of the Almora group, comprising gneiss and schist, intruded by granite-granodiorite suit are exposed on the northern fringes of the Gola catchment.

III. GEOLOGY OF DAM SITE :

17. The proposed Jamrani Dam site is located on the Lower Siwalik rocks, which consist of sandstone alternating with siltstone and claystone. The detailed

geological mapping of the dam site, on 1:1000 scale, has been carriedout. An area along the river from 350 m. upstream to 450 m. downstream of theproposed dam axis and on thebanks, from the river level (El. ± 635 m.) to El. ± 780 m. on the left bank and El. ± 800 m. on the right bank has already been covered. (Plate-2). The rock exposures are more abundant on the right bank, the left bank is largely covered by weathered rock/debris, supporting thick vegetation. The river bed section is occupied by about 20 m. deep river borne material.

18. The sandstone occurring at the dam site is grey and brown coloured, micaceous (biotite), fine to coarse-grained and at places friable due to poor cementation. Cross bedding, observed in sandstone about 200 m. upstream of the dam axis, indicate a normal order of superposition. The thick encrustations of calcareous material observed on the inner surface of the drifts indicate that the sandstone is occasionally calcareous. The micaceous claystone seen at the site is grey, brown and purple in colour and is generally weathered near the surface with many shrinkage cracks. About 10 to 15 cm. thick shearing is often decipherable along the contact of the two rocks. Occasionally the clay stone and siltstone contain intra- formational fragments of the same rock or siltstone siltstone respectively. The micaceous siltstone is generally dark grey, moderately hard and well cemented. The rocks show facies variation along their strike, as exemplified by the 3-5 m. thick siltstone-claystone beds on the right bank in the east attenuated to 0.5 to 1.0 m. in the west (Plate-2).

19. The Lower Siwalik rocks exposed at the dam site proper is tectonically less disturbed. Their bedding generally strikes NW-SE with dip of 30°-50° in

north-east direction i.e. upstream. This is a favourable di-sposition with respect to the tightnessof the foundation. Major geological, structural features like thrusts and faults etc. are conspicuously absent from the dam base area. However, minor shearing along sand-stone/claystone contact is seen at places. In addition to the bedding, there are several sets of joints traversing the Siwalik rocks at the dam site. For evaluating the pattern of bedding and joint at the site, 400 readings were noted. The data so obtained was plotted on an equal area, Schmidt's Steresnet (Plate-4) and has indicated the presence of the following discontinuities, in order of preponderence.

Discontinuity	Maxima of pole Concentration %	Strike	Dip	Remarks
Bedding joint.	15	N50°W	47°/N40°E	Upstream dipping into right bank.
Joint J_1	10	N39°E	68°/N51°W	Downstream dipping towards right bank.
Joint J_2	10	N60°E	66°/N30°W	- do -
Joint J_3	3-5	N70°W	57°/S20°W	Towards left bank.
Joint J4	3	N80°E	57°/S10°E	- do -

20. The stereonet study shows that the bedding planes and joints show high value of maxima of pole concentration (15%). The joint planes (J_1-J_4) show that J_1 has the highest value of maxima (10%) and J_4 the least value of maxima (3%). The moderately upstream dipping claystone beds would act as barrier for the sub-surface movement of water around the dam

after impoundment of the reservoir.

21. The gullies/torrents on the left bank, close to dam axis have moderate slopes on one side, controlled by bedding and steep slopes on the other side, controlled by NW dipping joints. The rock wedges formed due to the intersection of these two discontinuities may be of concern from the point of view of the stability of left abutment, during the foundation excavations. Hence adequate measures like provision of grouted anchors have to be thought of in the design to increase the shearing resistance along these discontinuities. The south dipping joints control the steep valley slopes on the right bank and would have greater significance for abutment stripping, on the right abutment.

22. On the basis of their exposures in the dam base area, it is assessed that sandstone constitute about 75% of the bedrock in the dam base area and the balance is siltstone and claystone put together. The claystone beds, 1-3 m. thick in the river bed and 3-5 m. thick at higher levels on the abutment consitute the weaker foundation members of the site. The claystone beds occurring at the foundation level may lead to differential settlement. As such, it would be necessary to remove them to a depth (below the general foundation level) to be determined by Shasta's formula and to back-fill them with concrete.

IV. SUB-SURFACE EXPLORATIONS :

23. A total of 25 drill holeshave been put down at the site so far. The sub-surface data obtained from these holes is already discussed in the previous reports on the project. During the period under report, two more drillholes (nos. 25 and 26) have been completed at the site which are described below :-

D.H. 26 :

24. The drill hole No.26 was located at El. 759.3m., on the right bank of Churani nala, near Jamrani village. The hole, inclined at 70° was drilled to a length of 20 m. in the direction S10°E, i.e., across the inferred trace of the Main Boundary fault. It encountered Amritpur Granite down to 8.50 m. but yielded no core. In the vicinity of the Main Boundary Fault, the Amritpur granite, is sheared and traversed by closely spaced joints and breaks into small pieces during drilling. This perhaps explains the total core loss in the drill hole. Lower Siwalik rocks were encountered from 8.5 m. downwards. A 75 cm. thick claystone, encountered in the hole initially, is pinkish in colour and the core show slaking (break up) on exposure to atmosphere. Pinkish, hard and indurated sandstone occurred in the hole from 8.50 m. to 18m. The sandstone encountered farther down is grey coloured. The percent core recovery is generally more than 50 and the Rock quality Designation (RQD) is also generally fair (50-75%) beyond 11.5 m. Water percolation tests in the drill hole, performed in two sections, 11.5 to 16 m. and 16 to 20 m., indicate the permeability values to be 7.5 and 10.2 lugeons respectively (Plate-6).

D.H. 27 :

25. The hole No.27 was located at El. 645.2m., on the right bank road about 30 m. upstream of the dam axis. It was drilled to a depth of 15.5 m. for performing Goodman's Jack Tests. The hole encountered sandstone in the entire depth with a 1 m. thick siltstone from 12.5 m. to 13.5m. (Plate- 7). The percent core recovery in the hole is generally more than 50 and ranges upto 88. Though RQD is generally fair (50-75%) down to 3.5m., it is poor (25-50%) farther

downwards. It is probably because of the fast drilling undertaken to complete the hole in just over a day for conducting the Goodman's Jack Test.

V. TEST GROUTING :

26. For carrying out the test grouting a platform was selectee on the right bank about 35 m. upstream of thedam axis (Plate-8). The testing was carriedout using a 3 m. square pattern of four holes with an inspection hole in the centre. Against the planned depth of 40 m., the testing could be carriedout to a depth of only 14 m. in three stages of 5-8 m., 8-11m., and 11-14 m. The 50-60 cm. thick overburden at the location was not removed and the underlying rocks were grouted to a depth of 5 m. to form a grouted cap. The rocks encountered in the test reaches of the holes are sandstone.

27. The pre-grouting water percolation tests in the holes indicated the permeability values to be generally more than 20 lugeons for the first two stages. However the pregrouting permeability of 11-14 m. stages is less than 6 lugeons and generally around 2 lugeons. These low values of permeability obtained in this stage could be due to the effects of grouting of the previous stage, which might have sealed-off the joints and thereby reduced the permeability. However, the1st stage grouting did not similarly reduce the permeability in stage-2. The grouting data is still too meagre for detailed analysis.

28. The grout intake, in gene-ral, ranges from 10 to 33.3 kg/m. and the average grout intake is 14.6 Kg/m. for 5-8 m. stage, 26.8 Kg/m. for 8-11m. stage and 13.7 Kg/m. for 11-14 m. stage. The efficacy of grouting is 96.52% for 8-11 m. stage and 53.48% for 11-14 m. stage. It is not known for 5-8 m. stage because the

pre-grouting permeability of 'I' hole is not available. The results of grouting tests are summarised in the appendix-II.

VI. SEISMICITY :

29. The Seismic Zoning Map of India prepared by the Indian Standards Institution places the dam area in zone IV for which an earthquake coefficient of 0.05 g. is recommended for ordinary and double this figure for major structures. Although, complete data on incidence of past earthquakes in the area is not available to the author, an study of the available data upto 1966 indidates that the epicentres of a few shocks, with magnitude of 5 are located about 100 kg. north and north-east of the project site.

30. The most important, tectonic feature present in the area is the Main Boundary fault seperating the Siwalik sedimentaries of the outer Himalaya from the Amritpur Granite of the Lesser Himalaya. It traverses through the reservoir and cuts across the river Gola about 3.5 km. upstream of the dam site. However, its seismic status is still not fully known.

31. The geological environments of the proposed reservoir is characterised by alternations of claystone- sandstone, and is similar to that at Bhakra, Ramganga and Pong dams in India, Mangla and Tarbela in Pakistan. Srivastava et al (1982) and Valdiya(1986) have pointedout that these dams have not shown any significant Reservoir Induced Seismicity (RIS), because of the presence of plastic rocks, which, under deformation, may show settlement without producing viberations. Therefore, it may be quite logical to conclude that there may not be much of an R.I.S. at the Jamrani dam project.

VII. CONSTRUCTION MATERIAL :

32. It has been estimated that about 2 million m^3 of aggregate would be required for the construction of a concrete dam at the site. This quantity would be obtained from the river borne material within 3-5 km. downstream of the dam site. The suitability of these materials for concrete aggregate is under evaluation by the project authorities. A detailed quantitative evaluation of the material available is yet to be taken up by the project authorities. As an alternative, it is suggested that the possibility of using Amritpur Granite, exposed to the north of the dam site, above El. ± 10000 m., for using as concrete aggregate material may also be evaluated. The granitic area is approachable by the Anna-Babiyar, road under construction by P.W.D. which traverse through Amritpur Granite and takes a hair-pin bend above the dam site. Since the Amritpur Granite is exposed in a width of 3-5 kms., sufficient quantity of aggreg-ate could be obtained from this source, if it is found suitable after customary tests. The blasted material after proper mixing could be taken down under gravity. However, the possibility of the aggregate getting crushed to very small size would have to be studied in detail. Alternatively, the aggregate could be transported to the site by an aerial ropeway.

33. The Barajhala drift (El. 680 m.), excavated in 1980 was re-examined in detail and was logged geologically in detail for a length of 33.5 m. Drift is located in quartzite, about 2 km. downstream of the dam site (Plate-5). The drift was excavated by the project authorities to explore the continuity of rock for rock-fill material quarry. The drift wasalso examined with a view to assess the availbility of

suitable-size rock blocks for masonry dam alternative. The rock encountered in the drift is traversed by very closely spared joints, dipping in all directions. The southerly dipping joints show longer strike continuity. Because of the closely spaced joints, it may not be possible to obtain rock blocks for the masonry dam alternative from this source.

VIII. CONCLUSIONS AND RECOMMENDATIONS :

34. The Jamrani dam project envisages the construction of a 130 m. high dam across river Gola in Nainital district, U.P. for an additional irrigation of 64,500 ha. of land in the Bhabar area of the district and generation of 20 MW of power.

35. Rocks occurring at the dam site and its vicinity are sandstone interbedded with claystone and siltstone beds belonging to the Siwalik Group. The bedding in the rocks generally strike NW-SE and dip 30°-50° in NE direction, i.e., upstream, which is a favourable disposition. Stereonet analysis of the joints have indicated the presence of 4 prominent sets of joints.

36. Towards north of the dam site and towards farther east in the reservoir area, the Siwalik Group of rocks lie in contact with Amritpur granite. The contact between the two types of rocks is marked by the Main Boundary Fault.

37. A concrete gravity dam is envisaged at the site. The difference in the physical parameters of the sandstone and siltstone/claystone at the site would necessitate suitable dental treatment of the weaker bedrock members for uniform dispersal of stresses.

38. An inclined drill hole across the inferred trace of the Main Boundary fault has indicated that the permeability of the thrust zone material is limited to 7.5 to 10 lugeons. This low value is unlikely to cause reservoir leakage.

39. The test grouting data available at the dam site is still very meager. However, it indicates that the foundation rocks may be amenable to grouting. For achieving better washing of clayey fillings, deflocculating agents could be mixed with water. It may also be advantageous to use super fine cement in place of portland cement for grouting.

40. The dam site falls in zone IV of the Seismic Zoning Map of India. Major earthquakes having magnitude 5 are located about 100km. north and northeast of dam site. It is felt that the area may not show significant increase in RIS due to reservoir impoundment but further studies in this regard are necessary.

41. The required construction material for the proposed Jamrani concrete dam is planned to be obtained from the Gola river bed within 3- 5 km. downstream of the dam site. The Amritpur Granite, exposed to the north of dam site, could be considered as an alternate source. Quantitative and qualitative evaluation of the material is yet to be made.

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Dated: 9th. June'1987.

APPENDIX - I.

A. LIST OF UNPUBLISHED REPORT ON JAMRANI DAM PROJECT BY GEOLOGICAL SURVEY OF INDIA.

1. Dayal, H.M. (April' 1973) : A geotechnical note on the Ranibagh and Jamrani dam sites, on Gola river Nainital district, U.P. (With five plates). Field season 1972-73.

2. Dayal, H.M. (Dec. 1973) : Second geotechnical note on the interpretations of drilling data, Jamrani dam site, Gola river, Nainital district, U.P. (With three plates). Field season 1972-73.

3. Dayal, H.M. (Jan. 1974) : Third geotechnical note on the proposed dam and the appurtenant structures sites and interpretations of drilling data, Jamrani Dam site, Gola project, Nainital district, U.P. (With three plates). Field season 1973-74.

4. Dayal, H.M. (March, 1975): Fourth geotechnical note on the Jamrani dam project, Gola river, Nainital district, U.P. (With seven plates). Field season 1973-74).

5. Dayal, H.M. (Feb. 1976) : Fifth geotechnical report on the Jamrani dam project, Gola river, Nainital district, U.P. (With six plates). Field season 1974-75.

6. Dayal, H.M. (March, 1978): Sixth geotechnical note on the Jamrani dam project, Gola river, Nainital district, U.P. (With fourteen plates). Field season 1976-77.

7. Jaitle, G.N. : Geotechnical report on the Jamrani dam project, river Gola, district Nainital, U.P. (With two plates). Field season 1979-80.

8. Iyer, R.V., Anbalagan, R., Sanwal, R.K. : Geotechnical report on the Jamrani dam project, Gola river, Nainital district, U.P. (with eight plates). Field season 1980-81 and 1983-84 .

contd.

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5. Raina, B.N., Dungrakoti, B.D., 1966 : A note on a brief study of ingneous rocks and associatee formations of Pithoragarh and Askot area (Unpublished report of GSI).

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7. Valdiya, K.S., Joshi, D.D., Sanwal, R. and Tandon, S.K., 1984 : Geomorphic development across the ~~xxxxx~~ active Main Boundary Thrust, an example from the Nainital Hills, in Kumaun Himalaya. Jour. Geol. Soc. Ind. 25: 761-774.

8. Valdiya, K.S., 1986 : Environmental Geology : Indian Context. Tata Mc - Graw Hill Company New Delhi (inpress).

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APPENDIX-II.

(Analysis of Grouting Tests)

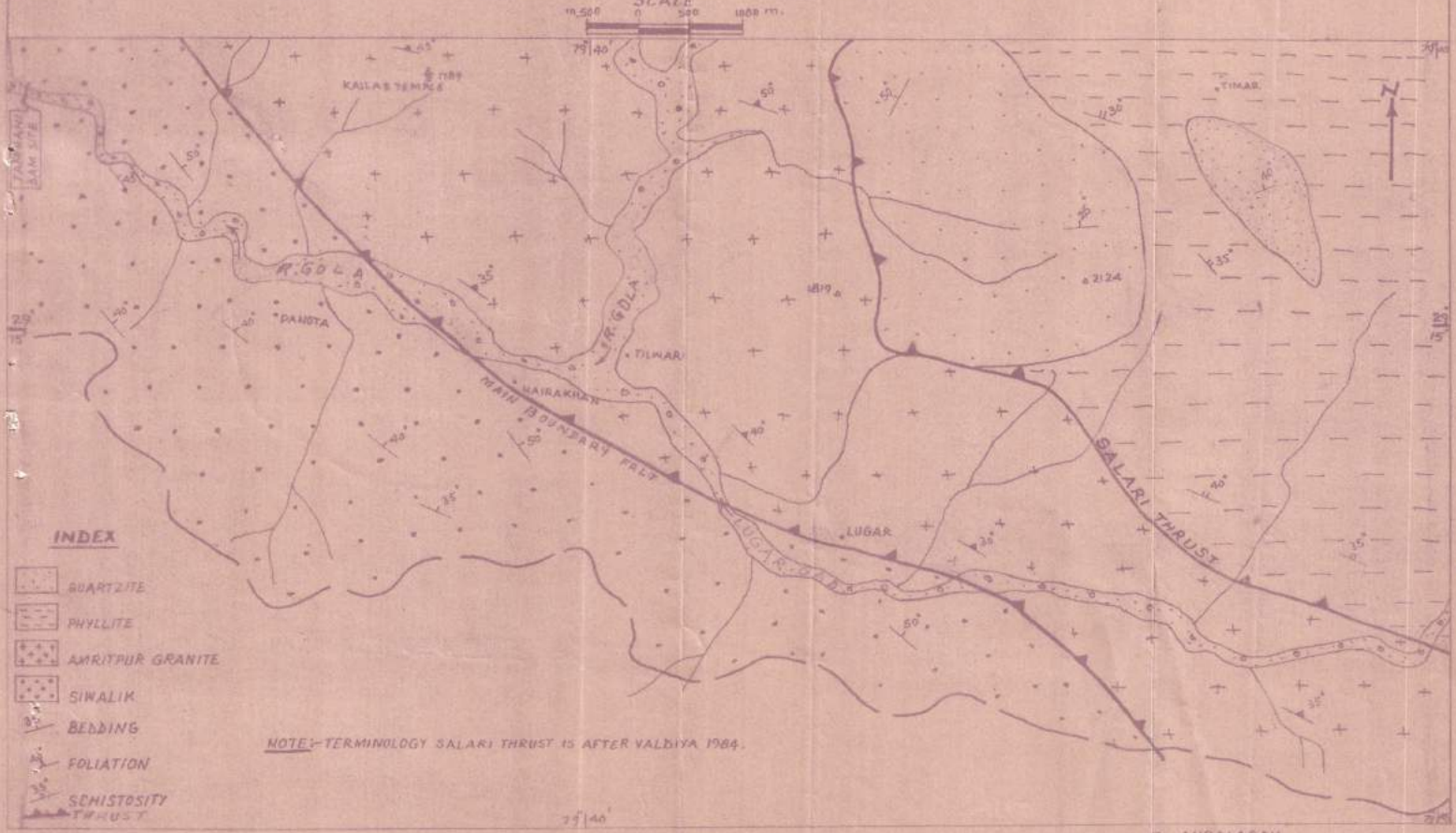
Stage	5-8M					8-11 M					11-14 M				
Hole No.	A	B	C	D	I	A	B	C	D	I	A	B	C	D	I
Permeability before grouting (lugeon).	24.7	7.64	11.4	Pressure not Developed.		28.8	23.1	38.9	45	39.4	6.0	2.7	2.8	0.87	0.43
Grout intake (Kg/M).	20	10	13.7	15	-	33.3	34	10	30	-	26.6	15	13.3	Nil	-
Average grout intake of stage (Kg/M).			14.60					26.8					13.7		
Permeability of 'I' hole after grouting (Lugeon).					45					1.37					0.20
Efficacy of grouting (%).					-					96.52%					53.48%

39.4
(-) 1.37
38.03

38.03 × 100 / 39.4 = 96.52%

PLATE - I

REGIONAL GEOLOGICAL MAP AROUND JAMRANI DAM SITE



R. ANBALAGAN
GEOLOGICAL SURVEY OF INDIA
F.S. 1985-86

JAMRANI DAM PROJECT

GEOLOGICAL MAP OF DAM SITE

SCALE

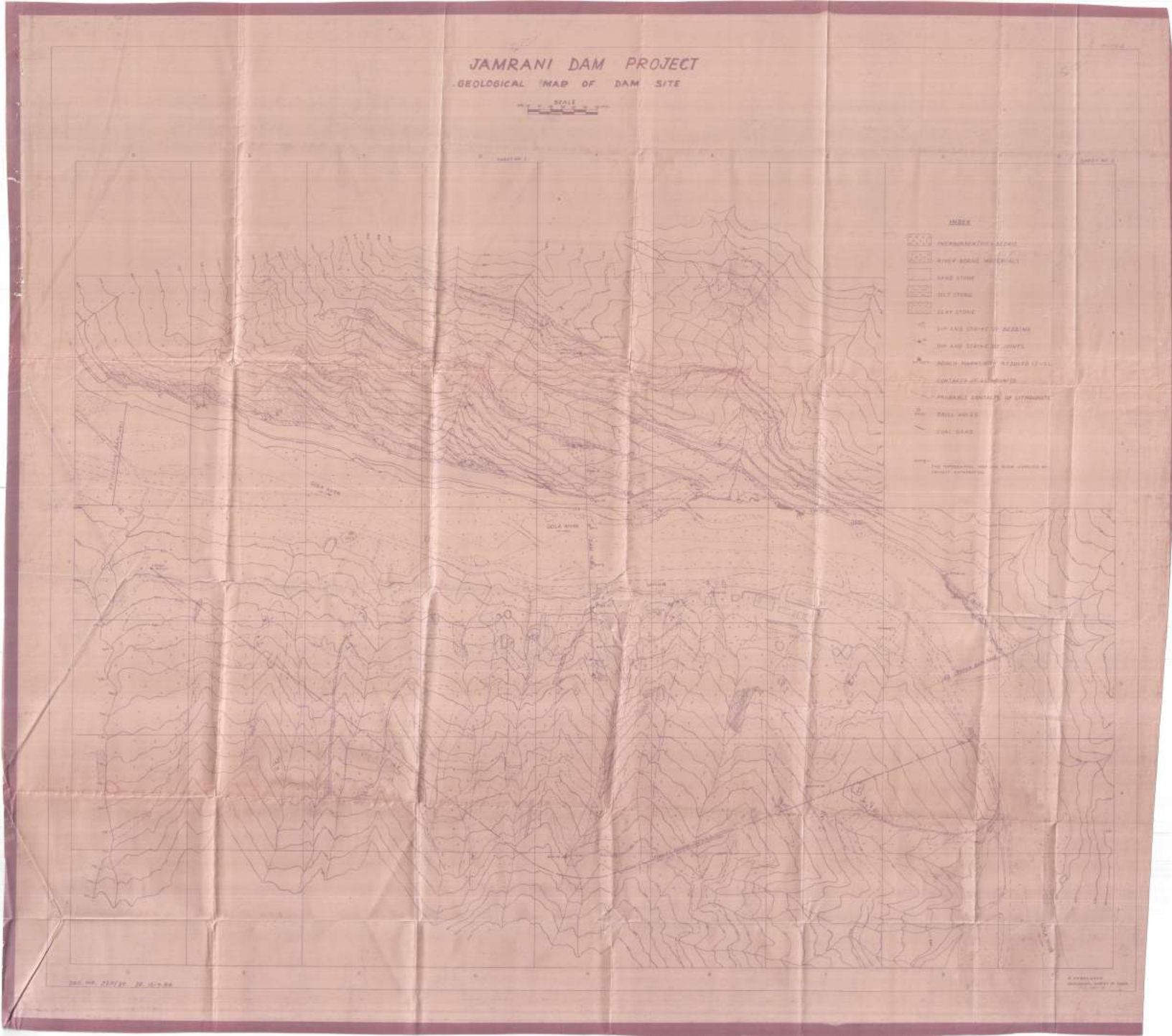
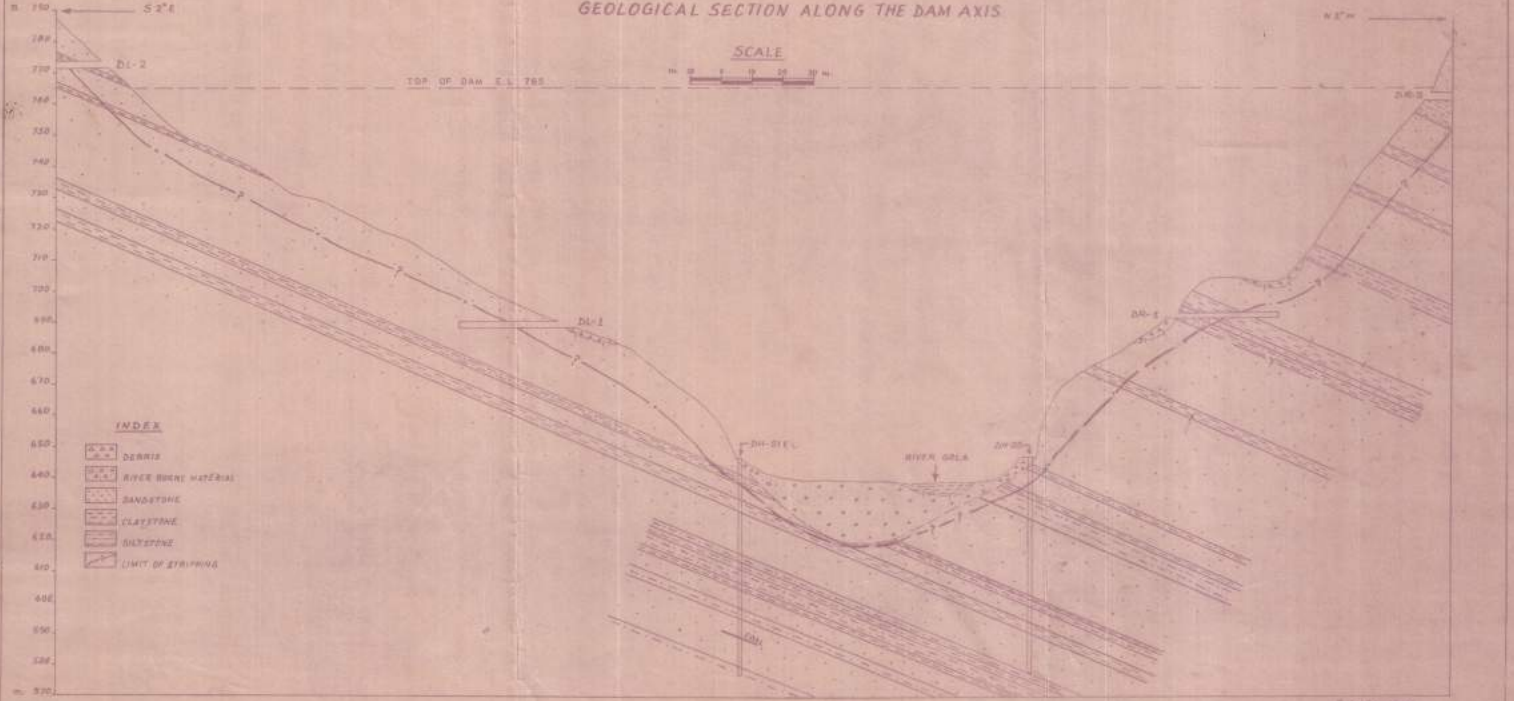


PLATE III

JAMRANI DAM PROJECT

GEOLOGICAL SECTION ALONG THE DAM AXIS

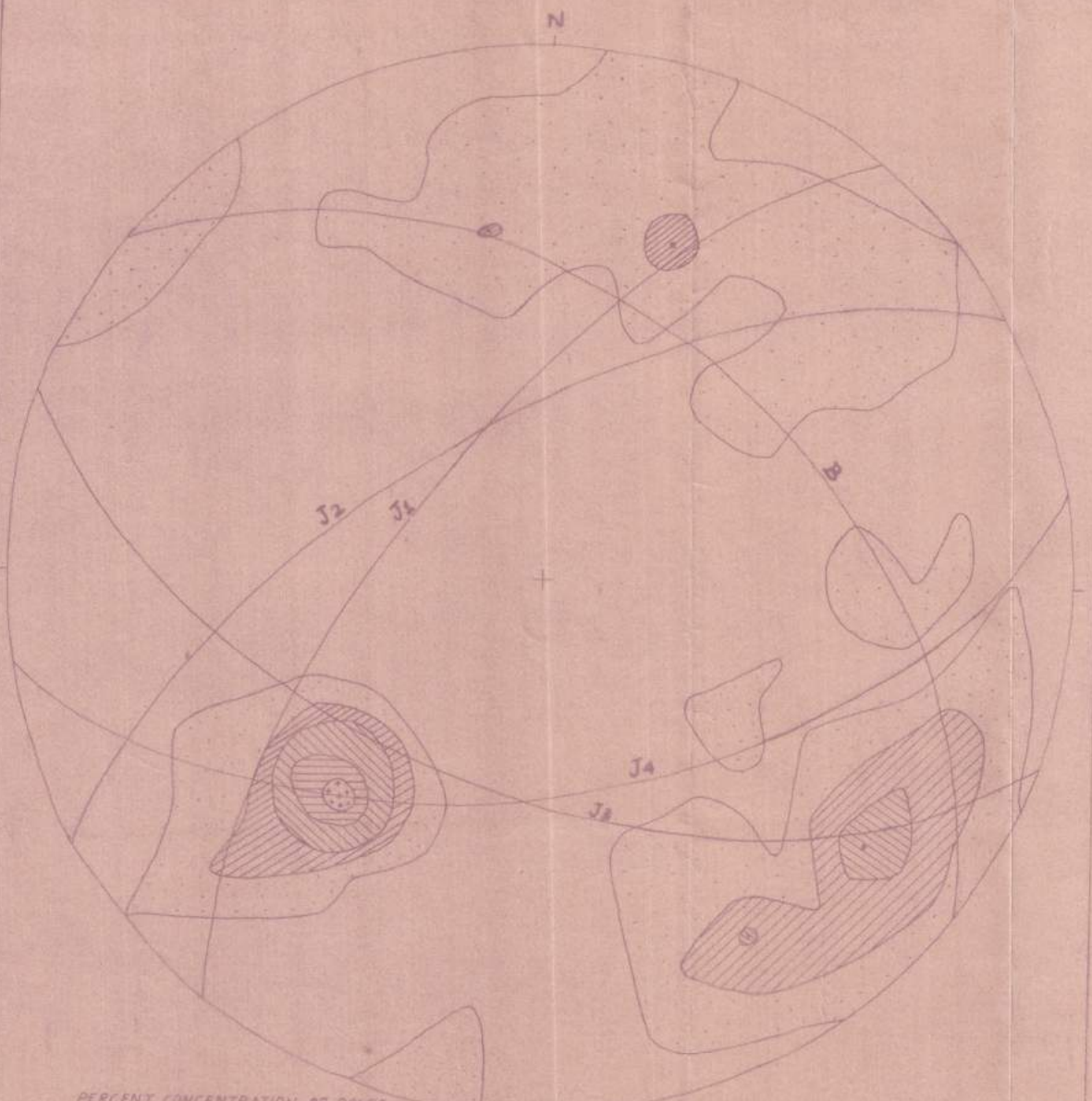


R. SUBRAMANIAN
G.S.I. TS 1967-68

PLATE IV

JAMRANI DAM PROJECT

STEREOPLOT OF STRUCTURAL DISCONTINUITIES AT DAM SITE



PERCENT CONCENTRATION OF POLES

1-3 3-5 5-10 10-15 >15

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F.S 1985-86

PLATE IV

JAMRANI DAM PROJECT

3-D GEOLOGICAL LOG OF BARAJHALA DRIFT

NOTE

1. THE ELEVATION OF THE DRIFT IS 680 m.
2. THE ROCK ENCOUNTERED IN THE DRIFT IS GRANITE.
3. THOUGH THE ROCK IS CLOSELY JOINTED, ONLY THOSE PROMINENT JOINTS HAVING LONGER CONTINUITY ARE PLOTTED.

SYMBOL

55°, W 30°E AMOUNT OF DIP AND DIRECTION

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GEOLOGICAL LOG OF DRILL HOLE

PROJECT - JAMRANI DAM PROJECT

STATE - UTTAR PRADESH

FEATURES- ACROSS MAIN BOUNDARY FAULT, TO THE RIGHT OF CHURANI NALA, NEAR JAMRANI VILLAGE

STARTED- 9-12-85

TYPE OF BIT USED (WITH DEPTH)- DIAMOND

CO-ORDINATES N/Ch - E/Stn -

COLLAR ELEVATION- 759·3 m.

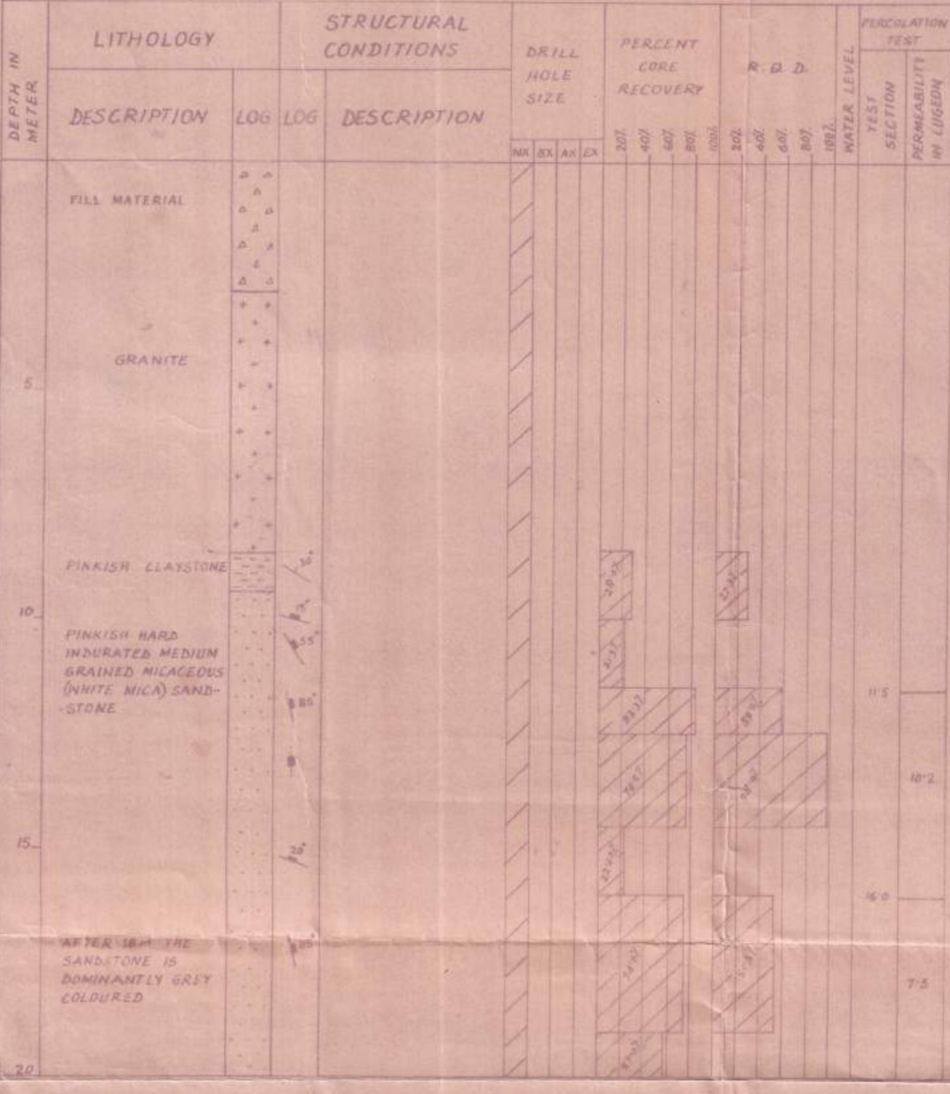
COMPLETED - 21-3-86

HOLE NO- 26

BEARING OF HOLE- S 10° E

ANGLE WITH HORIZONTAL- 70°

TOTAL DEPTH- 20 m.



SPECIAL OBSERVATIONS AND INTERPRETATIONS

<u>OVERBURDEN</u>

IT EXTENDS FROM SURFACE DOWN TO 2·80 m COMPRISING FILL MATERIAL.

<u>ROCK</u>

THE HOLE ENCOUNTERED AMRITPUR GRANITE FROM 2·80 m TO 8·50 m. NO CORE HAS BEEN OBTAINED IN THIS REACH. THIS CAN BE ATTRIBUTED TO THE FACT THAT THE AMRITPUR GRANITE IS TRAVERSED BY CLOSELY SPACED JOINTS AND THE SHEARED GRANITES DURING ROTATION BREAK IN SMALL PIECES TO YIELD CUTTINGS OF THE ROCKS.

LOWER SIWALIK ROCKS ARE ENCOUNTERED FROM 8·50 m DOWNWARDS. THE CLAYSTONE ENCOUNTERED INITIALLY IS PINKISH IN COLOUR AND THE CORES SHOW SLACKING BREAK UP ON EXPOSURE TO ATMOSPHERE.

THE MEDIUM GRAINED, MICACEOUS, HARD AND INDURATED SANDSTONE IS PINKISH IN COLOUR FROM 9·30m TO 18m AND GREY COLOURED FURTHER DOWN.

IT WAS POSSIBLE TO CARRY OUT WATER PRESSURE TESTS ONLY IN TWO STAGES WHICH INDICATE PERMEABILITY VALUES RANGING FROM 7·5 TO 10·2 LUGEONS.

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GEOLOGICAL LOG OF DRILL HOLE

PROJECT- JAMRANI DAM PROJECT

STATE- U. P.

FEATURES- ON RIGHT BANK ROAD 30 m U/S OF DAM AXIS

STARTED- 6-2-86

TYPE OF BIT USED (WITH DEPTH)- DIAMOND

CO-ORDINATES N/Ch- E/Stn-

COLLAR ELEVATION- 645·2 m.

COMPLETED- 7-2-86

HOLE NO- 27

BEARING OF HOLE-

ANGLE WITH HORIZONTAL- 90°

TOTAL DEPTH- 15·5 m.

DEPTH IN METER	LITHOLOGY		STRUCTURAL CONDITIONS		DRILL HOLE SIZE	PERCENT CORE RECOVERY	R.Q.D.	WATER LEVEL	PERCOLATION TEST		SPECIAL OBSERVATIONS AND INTERPRETATIONS
	DESCRIPTION	LOG	LOG	DESCRIPTION	NX BX AX EX	20% 40% 60% 80% 100%	20% 40% 60% 80% 100%		TEST SECTION	PERMEABILITY IN LUGEON	
	FILL MATERIAL 0·3 m. TO 2·10 m. COARSE GRAINED FAIRLY WELL CEMENTED AND MICA-CEOUS SANDSTONE CONTAINING PEBBLES OF 0·5 TO 1·0 cm. SIZE. 2·0 m. TO 12·50 m. MEDIUM TO COARSE GRAINED, GREY TO BROWN MICACEOUS, AND WELL CEMENTED SANDSTONE CONTAIN-ING OCCASIONAL PEBBLES.										OVERBURDEN IT EXTENDS FROM THE SURFACE DOWN TO 0·30 m DEPTH COMPRISING FILL MATERIAL.
5											ROCK LOWER SIWALIK SEDIMENTARY ROCKS ARE ENCOUNTERED FROM 0·30 m. DOWNWARDS COMP-RISING SANDSTONE WITH A MINOR BAND OF SILTSTONE. THE SANDSTONE IS GREY TO BROWN COLOURED, FINE TO COARSE GRAINED, MICACEOUS, FAIRLY WELL CEMENTED AND PEBBLY AT CERTAIN REACHES. THE SILTSTONE IS DARK GREY COLOURED. HARD AND WELL CEMENTED. THE PERCENT CORE RECOVERY IS GENERALLY MORE THEN 50% AND RANGES UPTO 88%, THOUGH THE ROCK QUALITY DESIGNATION (RQD) IS GENERALLY FAIR UPTO 3·50 m. DEPTH, IT IS POOR FURTHER DOWNWARDS. IT IS PROBABLY BECAUSE OF THE FAST DRILLING MATHODS EMPLOYED TO COMPLETE THE HOLE IN JUST OVER A DAY FOR CARRYING OUT THE GOOD-MAN'S TEST.
10											
	DARK GREY COLOURED HARD AND WELL CEMENTED SILTSTONE										
15	FINE TO MEDIUM GRAINED GREY COLOURED AND MICACEOUS SANDSTONE										
20											

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