Geotechnical Appraisal of Lakroh Minihydel Project, Jaintia Hills District, Meghalaya

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Abstract

Lakroh Mini Hydel Project envisages construction of about 5 m high masonry weir across Lakroh river, a tributary of Umngot river near Lakroh village (25°08'N:92°14'E, 83 C/4) at elevation 248 m. The water will be conducted through a 808 m long rectangular power channel with 1.15 cumec design discharge to the powerhouse through forebay and 340 m long penstock for generating 1.5 MW of power using 165 m head. The project area is located at the fringe of Meghalaya plateau close to Bangladesh plains. Archaean granitic rock and metabasic rocks intruded by pegmatite and vein quartz unconformably overlain by Tertiary sandstone and interbedded conglomerate constitute the lithology of the Project site and its environs. At the proposed weir site, 25 m wide Lakroh river flows towards S 30°E and the weir alignment is N 65°E-S 65°W. Right bank slope (60°-65°) is steeper than the left bank slope (45°-50°). Slightly weathered to fresh, hard quartzitic sandstone belonging to Shillong Group are exposed at the weir site from river bed upto 10 m above. The rocks show E-W strike with 5° to 8° dip towards south and are dissected by three sets of joints. So the weir can be constructed over bedrock itself. The proposed 808 m long open power channel will pass through mainly slopewash debris material comprising subangular gravels / boulders/pebbles of conglomerate and sandstone with some intermittent exposures of sandstone and conglomerate. Maximum cutting for the power channel will be around 5 m to 6 m while the average will be 3 m to 4 m. Excavation of water surcharged debri material and jointed sandstone may cause slope failure. Moderation of slope alongwith provision of cross drainage across power channel are to be considered. The proposed forebay site shows presence of slopewash debri material consisting of boulders and pebbles of sandstone set in dark grey coloured silty matrix. For providing platform for construction of forebay, excavation of hill slope will be necessary. For stability of the excavated hill slope, it is suggested to provide suitable slope with 3 m wide berms at suitable height intervals – with proper drainage arrangements. Shotcreting of slope face is also suggested to be considered. One penstock pipe 340 m long and 0.75 m dia will carry the water over the hillslope. This part of hill slope appears to be stable. Anchor blocks of penstock pipe are to be laid over weathered rock and at places on soil. Since bedrock is not available at reasonable depth, provision of raft foundation is to be kept for anchor blocks to be found on soil. The site for the proposed surface powerhouse is devoid of any rock exposure and occupied by soil mixed with slopewash debri and boulders / pebbles of sandstone. Heavy cutting (say 30 m) will be required for creating platform for powerhouse and its ancillary structures – which can cause slope failure. So for arresting slope failure, shotcreting of excavated faces, provision of benches at suitable interval and retaining wall in back slope and drainage arrangements are recommended. The area belongs to seismic zone V and the active Dawki Fault is located very near to the project site. Proper seismic coefficient, hence, is suggested to be incorporated in design.

Introduction

Lakroh Mini Hydel Project envisages construction of a 5m high masonry weir across Lakroh river, a tributary of Umngot river near Lakroh village (25°08': 92° 14', 83C/4). This water will be conducted through a 808m long rectangular power channel with 1.15 cumec design discharge to the surface power house through forebay and 340m long penstock for generating 1.5MW of power using 165m head. This Project area is located about 5 km by road from Muktapur village

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near Bangladesh Border. Muktapur is approachable from Shillong NH-44 upto Jowai and from there by 52km long Jowai – Muktapur Road.

Regional Geology

The Project area is located at the fringe of Meghalaya plateau close to Bangladesh Plains. Lakroh river flows along deep gorge towards southerly direction from north through a very deep V shaped valley within the plateau before it enters the Bangladesh Plains. Numerous waterfalls in the form of cascades were noted throughout the river course. Archaean granite with pegmatite and quartz vein and metabasic bodies unconformable overlain by Tertiary sandstone and interbedded conglomerates constitute the rock types of the project site. Granite is fresh, hard, medium to coarse grained. Metabasic rocks of 5 to 6m width with N 85° W- S 85°E trend and dissected by a number of joints were observed. Granite is overlain by thickly bedded, coarse grained sandstone and interbedded conglomerate with a probable unconformity. Thickness of individual sandstone beds range between 2m and 5m. Conglomerate beds are 0.5m to 1m thick and composed of pebbles and cobbles of quartzite, vein quartz, granite and sandstone embedded in a siliceous matrix. Sandstone and conglomerate are hard and dip gently 5° to 7° towards south and southwesterly (S 60°W) i.e. towards downstream and towards valley as seen in left bank of Lakroh rivulet and dissected by joints. Dawki Fault occurs at the south of the project site.

Geotechnical appraisal of the scheme

Weir

At the proposed weir site(EL248m), Lakroh river flows towards S 30°E direction. The proposed weir alignment is N 65°E-S65°W. River flows through narrow gorge section as steeply descending rapids. Average width of the riverbed is about 20-25m. Both the banks are steep and rocky. Right bank slope is 60°-65° whereas left bank slope is 45°-50°. At the proposed weir site, slightly weathered to partially fresh, hard quartzitic sandstone are exposed upto 10m above the river bed. This rock shows E-W trend with southerly dip (5°-8°) .The rock has been dissected by the following two sets of joints:-

a)J_1 = N 25° E-S25°W strike with 80° – 85° dip towards east (Left Bank), spacing 5-20cm, smooth, planar, unfilled, opening 2mm.

2)J_2=N 80°W-S80°E strike ,vertical, smooth, planar, spacing 20-50cm, tight, opening <2mm.

The entire weir structure will be housed over the quartzitic bedrock. From the over all appearance, the site for construction of 5m high weir appears to be feasible. However, monitoring of movement of large boulders at the upstream is required. As such, it is advisable to have a storage reservoir upstream of the proposed trench weir at an appropriate stage for firming up power generation.

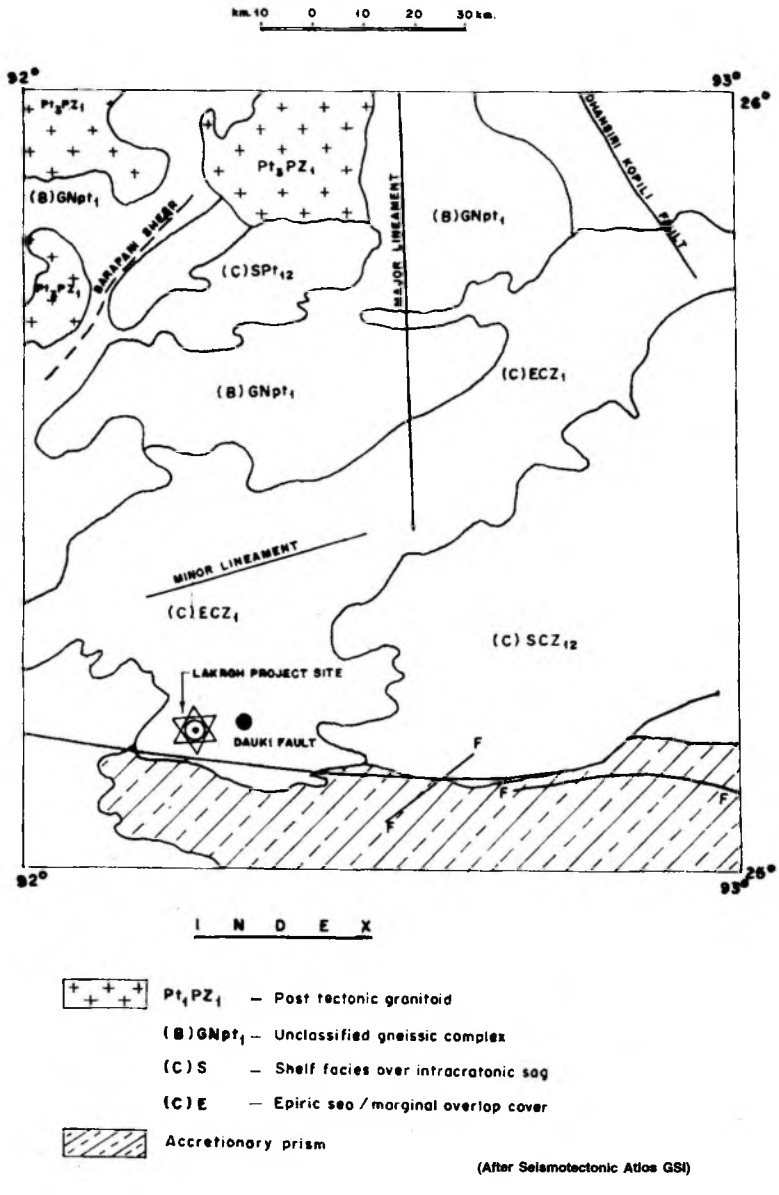
Power Channel

The proposed 808m long rectangular outlined power channel will pass through mainly slope wash debri material comprising sub angular boulders and gravels of conglomerates and sandstone with some intermittent exposures of sandstone and conglomerate. This conglomerate consists of sub rounded to well rounded pebbles of quartz, metabasic rock, chert embedded in sandy matrix. Maximum cutting involved will be 5m to 6mand the average cutting is 3m to 4m.. Slope appears to be stable. Proper necessary arrangements for drainage in the form of cross drainage and surface drainages above channel may be provided. For avoiding drainage provisions, cut and cover duct may be considered.

Forebay Site

The proposed forebay site shows presence of slope wash debris material consisting of boulders and pebbles of sandstone set in dark

REGIONAL GEOLOGICAL MAP OF LAKROH MINIHYDEL PROJECT



(After Seismotectonic Atlas GSI)

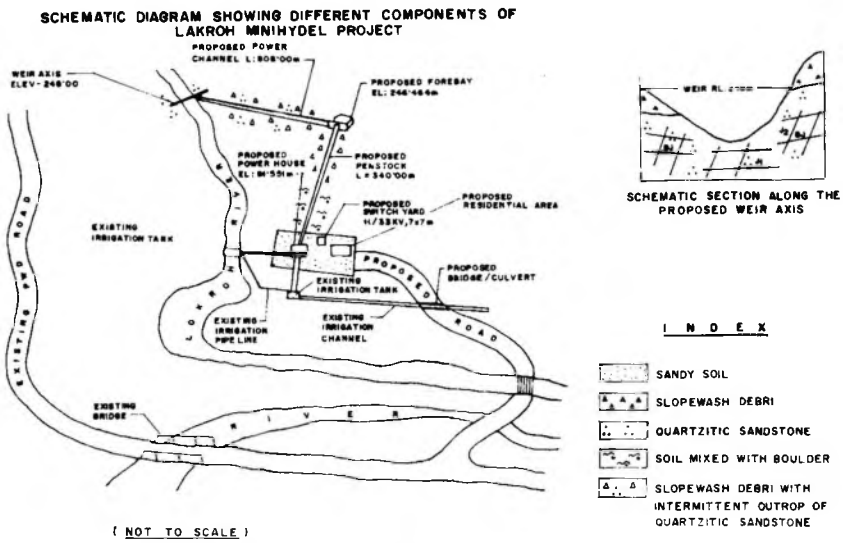
grayish coloured silty matrix. For providing platform for constructing forebay, excavation will be necessary on hill slope. For stability of the excavated hill slope, it is suggested to provide suitable slope with 3m wide berms at suitable height intervals with proper drainage arrangements. Shotcreting of slope face may also be considered.

Penstock Penstock alignment runs through deep overburden along dipslope and hence the anchor blocks may have to be designed for overburden foundation. Detailed slope stability analysis of penstock slope needs to be carried out.

Powerhouse

The proposed surface powerhouse is located at the left bank of Lakroh River and occurs at

Plate - II



EL. 81.551m. The overall head available will be 165 m. The proposed site for housing powerhouse is devoid of any rock exposure and is occupied by soil mixed with boulders/ pebbles of sandstone. Heavy cutting (say about 30m, as reported by the project Authority) will be required for creating a platform for powerhouse and its ancillary structure. Heavy excavation may lead to slope failure. So for arresting slope failure, shotcreting of excavated face, provision of proper drainage arrangement may be considered. As such the powerhouse structure may have to be designed for overburden foundation.

Conclusions

Considering moderately high head of 165m, there is every chance of exerting heavy thrust on the powerhouse and penstock foundations, particularly in the lower reaches , properly designed and founded anchor blocks, counter sliding measures like shear keys across penstock alignment, well founded powerhouse with protected valley side slopes are to be provided. Field and laboratory tests for load bearing capacity and shear parameters of overburden materials of forebay, penstock and powerhouse sites may be necessary for designing the project components. The micro hydel scheme as shown by the project Authorities has no component for desilting arrangement. Provision of proper desilting arrangement may be considered so that the suspended sediments from direct knowing water do not cause any damage to the turbine of the powerhouse. The project site is locate very near to Dawki Fault zone where incidence of seismicity is fairly high. Steep gravity gradients and strong positive Bouger Anomaly points towards higher tectonic activity. A number of damaging earthquake occurred surrounding this area of magnitude varying between 3.9 and 5.6. So proper safe suitable seismic coefficient is to be taken in design as this zone belongs to Seismic Zone V.

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Reference

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