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Stability Assessment of Underground Power House Encountering Shear Zone: Sunni Dam Hydroelectric Project (382 MW), India

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Abstract : Sunni Dam Hydroelectric Project (382 MW) is a run of river type development with an underground powerhouse, proposed to harness the hydel potential of river Satluj in Himachal Pradesh, India. The project is located in the inner lesser Himalaya between Dhauladhar Range in the south and the higher Himalaya in the north. The project comprises two large underground caverns, a Powerhouse cavern (171m long, 22.5m wide and 51.2m high) and another transformer hall cavern (175m long, 18.7m wide and 27m high) and the rock pillar between the two caverns is 50m. The highly jointed, fractured, anisotropic rock mass is a key challenge in Himalayan geology for an underground structure. The concern for the stability of rock mass increases when weak/shear zones are encountered in the underground structure. In the Sunni Dam project, 1.7m to 2m thick weak/shear zone comprising of deformed, weak material with gauge has been encountered in powerhouse cavern at 70m having dip direction 325 degree and dip amount 38 degree which also intersects transformer hall at initial reach. The rock encountered in the powerhouse area is moderate to highly jointed, pink quartz arenite belonging to the Khaira Formation, a transition zone comprising of alternate grey, pink & white quartz arenite and shale sequence and dolomite at higher reaches. The rock mass is intersected by mainly 3 joint sets excluding bedding joints and a few random joints. The rock class in powerhouse mainly varies from poor class (class IV) to lower order fair class (class III) and in some reaches, very poor rock mass has also been encountered. To study the stability of the underground structure in weak/shear rock mass, a 3D numerical model analysis has been carried out using RS3 software. Field studies have been interpreted and analysed to derive Bieniawski's RMR, Barton's "Q" class and Geological Strength Index (GSI). The various material parameters, in-situ characteristics have been determined based on tests conducted by Central Soil and Materials Research Station, New Delhi. The behaviour of the cavern has been studied by assessing the displacement contours, major and minor principal stresses and plastic zones for different stage excavation sequences. For optimisation of the support system, the stability of the powerhouse cavern with different powerhouse orientations has also been studied. The numerical modeling results indicate that cavern will not likely face stress governed by structural instability with the support system to be applied to the crown and side walls.

Keywords : 3D analysis, Himalayan geology, shear zone, underground power house
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