ABSTRACT

Dams play an essential role in the development of every country. According to the World Register of Dams, more than 62000 large dams are worldwide. India is the world's third largest country, having 6,138 large dams after China (24,089) and the USA (10,158). Research on practical problems such as erosion of foundation rock, flood control, sediment management and structural stability in dam engineering is essential for the safety of the age-old dams. Deep scouring of the riverbed is possible on the downstream side of the overflow section due to the plunging jet of water from the energy dissipater. Once plunge pool erosion occurs, it is difficult to say in which direction the erosion is progressing due to the jet power from the energy dissipater. The flow was simulated using the available software tool to know the jet impact inside the plunge pool. The stability evaluation is necessary to check whether the dam is safe under different erosion conditions. The main objective of this study is to know the stress variations in the dam and its impact on the stability due to different possible erosion conditions. MIDAS GTS NX software was used to perform the finite element method to analyse the dam with foundation rock erosion. The analysis is validated with the stresses calculated analytically using fixed base conditions. Three possible erosion conditions are considered to find its implications.

The vertical progression of erosion by increasing the scour depth only vertical direction. Three geometries in addition to the current condition are generated and analysed to find the stress path variation. The comparison was made with all the conditions to know the impact on the dam stability.

The forward erosion by increasing the depth and increasing the erosion on downstream side face of the plunge pool. The different geometries are prepared by increasing the depth as well as increasing the scour on downstream side of the plunge pool. All the models are analysed and plotted the stress values along the base of the dam to know the impact on the dam stability.

The backward erosion by increasing the depth and increasing the erosion on upstream side face of the plunge pool. The different geometries are prepared by increasing the depth as well as increasing the scour on upstream side of the plunge pool. All the models are

analysed and plotted the stress values along the base of the dam to know the impact on the dam stability.

The results indicated that, the vertical erosion and the forward the erosion away from the dam toe is not having prominent effect to the stability of the dam.

However, the backward erosion or erosion towards the dam also analysed and the stress path along the base width of the dam was plotted to check the impact due increasing the scour depth and erosion on upstream side face of the plunge pool.

The analysis shown that, the erosion towards the dam condition the geometry created by increasing the depth to 65 m and 75 m by changing the upstream profile of the plunge pool which is starting from 27.1m and 17.31 m from the toe of the dam. The stresses are exceeding the allowable stresses which given by the IS 6512:2019.

The history of erosion is also analysed by plotting the location of the maximum depth to its corresponding year. This shows the shifting of the location of the maximum depth point away from the tow of the dam matches the pattern with forward erosion that is erosion away from the dam.