

Discuss the risks associated with the flow of water below dams and define the cri...

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**ASSIGN
BUSTER**

Discuss the risks associated with the flow of water below dams. To assist with your discussion define the critical hydraulic gradient. Discuss the factors that influence the calculation of the critical hydraulic gradient and the environmental implications if your calculations are wrong! Present case studies to illustrate your discussions incorporating appropriate referencing. The soil below dams may aid in the seepage of water below the dam itself. Seepage of water in dam sub surface soil would lead to an upward force on soil particles. On the other hand, the weight of the dam itself and the weight of the dam sub surface soil would tend to exert a downward force on the soil particles. When the downward force on such soil particles equals the upward force, the soil particles are at zero stress. This allows a free movement of dam subsurface soil particles which serves to enhance already existing seepage. The afore mentioned seepage leads in turn to the creation of channels that catalyze dam sub surface flows in a process known better as piping (Rogers, 2010). A number of different environmental failures have occurred on account of flows below dams that eventually lead to compromised embankments and a sudden discharge of water after dam failure. The sudden release of water from such dam failures tends to devastate the ecosystems downstream of the failed dam. A relevant concept in such failures is the critical hydraulic gradient (i_c) that allows a calculation of when piping failures are most likely. In itself, the critical hydraulic gradient depends on the composition of the dam sub surface soil, the available head at the dam's bottom wall and the void ratio of the soil mass. The critical hydraulic gradient is seen as the hydraulic gradient that occurs when the vertical stress becomes zero (Vijayendra,

2012). Mathematically, the critical hydraulic gradient can be expressed as shown below (Vijayendra, 2012):

Where:

is the critical hydraulic gradient

is the specific gravity of the soil particles

is the void ratio of the soil mass

On another note, the critical hydraulic gradient may also be calculated using the relationship between soil characteristics and water characteristics as shown below (University of Mansoura, 2014):

Where:

is the submerged specific weight of the soil

is the specific weight of the water

As mentioned earlier, any loopholes in the calculation for the critical hydraulic gradient can mean the difference between dam failure and safe dam operation. There have been instances where dams have failed with only little warning due to the development of piping failures in the dam's sub surface soil. It is worth mentioning here that such dam failures are often rapid and provide little warning before hand of impending doom. One such case in point is the Baldwin Hills Reservoir failure where the embankment failed only after 9 years of service. There were essentially no major warnings before the failure occurred and once symptoms began surfacing, it took no time at all for the entire embankment to collapse and release water downstream. As a consequence of this failure, around 1000 homes were destroyed and 6 people lost their lives along with disastrous impacts for the ecosystems downstream (Rogers, 2010).

References

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