INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title:

Hydraulic Response and Stability Analysis of Earthen Dams subjected to Drainage Clogging and Hydraulic Fracturing

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SHORT ABSTRACT

The problem of dam failures has always sought attention of the researchers and engineers, owing to its devastating impact upon humankind and the environment. Studies have shown that poor drainage caused by clogging can result in drastic variation of the pore water pressures within the earthen dam, and can lead to substantial changes in the phreatic level with time, even reaching the higher limits of the downstream face. This scenario seriously influences the safety of the dams. Another factor that can lead to interior failure of earthen dams over a prolonged period is the hydraulic fracturing. There are documented cases of earthen dam failure within few hours after the first leakage was spotted, which is attributed to hydraulic fracturing during reservoir filling. In order to understand the detrimental effects of the above triggers, this dissertation reports about the influences of clogging of drainage blankets and hydraulic fracturing of the central impervious core in earthen dams. To assess the detrimental effect of drainage blanket clogging, firstly, different drainage blankets are introduced in the analyses, namely the horizontal toe drainage blanket and the inclined chimney drainage blanket. Homogeneous earthen dams, without or with fully functional or clogged drainage blankets, were investigated. The analyses were conducted considering different clogging scenarios for each blanket typology, and the outcomes are interpreted through the flow, stress-deformation and stability of the earthen dam. Hydraulic fractures in earthen dams is also addressed in this work, in which the tentative location of hydraulic fracturing is identified for homogeneous and zoned earthen dams. The possibility of hydraulic fracturing of the slope

faces of homogeneous earthen dams, are ascertained for its construction phase as well as for subsequent reservoir operations. This study is extended to zoned earthen dams where the tentative location of crack initiation on the faces of the central impervious core is identified with the aid of standard criterion correlating minimum effective principal stress and generated pore-water pressures. Finally, utilizing the standard criterion, a recursive numerical methodology is devised to identify the path of crack propagation through central impervious core, initiating from the identified location of crack initiation.