Internal erosion in dams and dikes: a comparison

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Abstract: Dams and dikes are both water-retaining earth embankments. These are vulnerable to internal erosion but specific differences lead to varying vulnerabilities to different types of internal erosion:

- Dams are usually zoned, with potential filtering capability to arrest piping if it is initiated, while dikes are more commonly unzoned and incapable of arresting erosion.
- Dams are usually higher than dikes, therefore the pressures are higher and leakages are more damaging.
- Dams have usually been built to their present height in one stage, dikes have often been improved over time, with a present crest height considerably higher than the initial height. In case of a significant raise, the original design assumptions no longer apply and modifications to the existing structure to provide sufficient safety may be costly.
- Dams have a limited crest length, while dikes may extend for hundreds of kilometres. This poses quite different possibilities and challenges for inspection and monitoring.
- Dams are built across a stream to block it, while dikes are built along it and only guide the stream. For the design and construction of dams the flow must be sufficiently blocked, including through the foundation. Many dikes on untreated sandy foundations are vulnerable to backward erosion.
- Dams always require provisions to pass the flow, for dikes this is rare. Concentrated leak erosion along culverts and spillways often poses a threat to dams but rarely to dikes.

Each of the above points will be illustrated by practical cases, focusing on the various mechanisms of internal erosion which are dealt with first.

Keywords: Internal erosion; dams; dikes, levees, flood and canal embankments; case histories; monitoring; remediation.

1 INTRODUCTION

The recent publication of ICOLD (International Commission on Large Dams) Bulletin 164 on internal erosion in existing dams, dikes and levees and their foundations (ICOLD 2016, 2015) has brought together knowledge and experience from research and practice to provide guidance on the causes of internal erosion and how to investigate, analyze, remediate and monitor earth water-retaining embankments to protect them against failure by internal erosion. ICOLD Bulletin 164 is referred to as ‘the Bulletin’ in this paper.

The ICOLD European Club Working Group on Internal Erosion (EWGIE) has played a central role in bringing this knowledge together. At its heart is the major advance in understanding of the mechanisms of internal erosion, an issue which has previously been dealt with by disconnected research programs, and approached in practice by qualitative and quantitative risk assessment. The mechanics of internal erosion, which apply to all types of earth water-retaining embankments, are described in the following section. Subsequent sections compare how internal erosion affects, and is dealt with, in dikes and embankment dams.