Transient protection for marine outfall

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ABSTRACT

Air intrusion, gas accumulations and sea water intrusion pose deadly threats to marine outfalls. For this very reason, the head chamber has been long considered as a panacea to these problems in most of outfall designs. However; expropriation issues, besides other hydraulic and coastal aesthetic constraints, sometimes step in to force the elimination of this vital structure. Although the present paper is concerned with the transient related threats that can undermine the structural integrity of the outfall, particular emphasis was placed on the protection measures and the alternative solution to the problematic tall head chamber frequently met in gravity driven outfall systems.

The incessant increase of using flexible plastic pipelines in marine outfall applications raises particular concern over their structural stability and the potential of failure. Indeed, the issue of air entrainment is still drawing large attention of designers since it has been routinely suspected of past accidents. Regrettably, scarce attention is being paid to the risk of full emptying that can emerge upon quick inflow shutdown to affect the foreshore sections of the outfall feeder whether the latter is made of rigid concrete or of plastic material.

The risk of failure stems from two critical facts, first, the under-pressure in the feeder, being magnified by the transients, can further worsen with the passage of maximum wave to cause a buckling failure. Second, the air-filled stretches, when subjected to an unexpected upward force, can lose their on-bottom stability initially verified for low air content. Only the transient analysis on outfall can provide an insight into the behaviour of the system subject to a number of boundary changes. The precise knowledge extracted from numerical modelling concerns both the factors that would lead to failure and the protective measures intended to prevent or mitigate their consequences.

This evaluation highlights the need for modelling the transient events, emphasizes the important role of the head chamber in protecting the system, and evaluates the performance of an alternative protection when shore constraints and hydraulic requirements congregate to force the elimination of this vital structure.

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