Title: PERFORMANCE EVALUATION OF REGULAR AND FIN-INTEGRATED OFFSHORE PIPELINES SUBJECTED TO TRANSVERSE PIPE DISPLACEMENT IN SOFT CLAYEY SEABED

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ABSTRACT

Buried offshore pipelines are crucial for the swift transportation of oils and similar fluidised materials from the oil rigs to the processing centre or vice versa. However, offshore pipelines are susceptible to buckling due to their high slenderness ratio, and the resistance to such displacement relies on pipeline stiffness and soil resistance. A novel alternative of integrating radial fins into these pipelines was explored through a series of 1g laboratory model tests and numerical methods to mitigate the global buckling of pipelines by enhancing the global buckling resistance. Thus, in this study, the pipe soil interaction during the global buckling of a fin-integrated pipe section (FP) has been explored and compared with the buckling behaviour of a regular pipeline to understand the feasibility of the FP in improving the buckling behaviour of a pipe section. To fulfil this primary objective, a series of scaled model tests have been performed, followed by several finite element analyses, by varying the number and orientation of radial fins, pipe embedment depth, strength parameters of soil, and the direction of buckling-induced pipe movement. In the current study, the pipe-soil interaction of the offshore pipelines was considered for surface-laid pipelines subjected to vertical penetration and buried pipe sections subjected to vertically upward and lateral displacement due to thermal buckling. Furthermore, the load-displacement behaviour of the pipe, pressure around the pipe section, soil surface heaving, and the displacement field within the surrounding soil were examined thoroughly and illustrated and discussed comprehensively. The observation from the experimental studies and the prediction from the numerical studies helped to understand the

buckling behaviour of offshore pipelines, along with the efficiency of the radial fins in enhancing the buckling resistance of the pipe sections. Moreover, a sensitivity analysis revealed the impact of various soil and geometric parameters on the buckling resistance and their order of influence. Finally, a general optimized pipe section was proposed to resist buckling in each direction by balancing the material consumption and the buckling resistance provided by the particular fin configuration.