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Fluid Structure Interaction of Offshore Concrete Columns under Explosion Loads

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Abstract : The paper describes the influences of the fluid and structure interaction in concrete structures that support large oil platforms in the North Sea. The dynamic interaction of the fluid both in 2D and 3D are demonstrated through a Computational Fluid Dynamics analysis in the event of explosion following a gas leak inside of the concrete column. The structural response characteristics of the column in water under dynamic conditions are quite complex involving axial, radial and circumferential modes. Fluid structure interaction (FSI) modelling showed that there are some frequencies of the column in water which are not found for a column in air. For example, it was demonstrated that one of the axial breathing modes can never be simulated without the use of FSI models. The occurrence of a shift in magnitude and time of pressure from explosion following gas leak along the height of the shaft not only excited the modes of vibration involving breathing (axial), bending and squashing (radial) modes but also magnified the forces in the column. FSI models revealed that dynamic effects resulted in dynamic amplification of loads. The results are summarized from a detailed study that was carried out by the first author for the Offshore Safety Division of Health & Safety Executive United Kingdom.

Keywords : concrete, explosion, fluid structure interaction, offshore structures
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