Multiscale Analysis of Multilayer Composite Pipes

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The use of composite materials in offshore applications has constantly increased towards the development of deepwater technology and ultra-deepwater feasibility. Cylindrical composite pipes are the most principal components in floating and offshore platforms. Composite pipes could be grouped into bonded and unbonded structures. Typical bonded composite structures comprise a core angle ply laminate cylinder sandwiched between an inner liner and an outer liner made of elastomer or metal alloys. On the other hand, unbonded composite pipes such as flexible pipes in floating platforms consist of multiple metallic and polymeric layers, among which tensile wires play essential roles in providing axial and bending stiffnesses. The flexibility in motion of each layers of the unbonded composite pipe and the complexity in their geometries and materials make the analysis of unbonded composite structures very challenging. In this work, multiscale non-linear analyses of unbonded flexible risers are carried out and the non-linear behaviors of individual riser layers as well as stick-slip mechanisms between them are studied. In addition, the work also discusses the potential of flexible fiber-reinforced pipe where metal armour strips may be replaced by fiber-reinforced composite materials to significantly enhance the structural performance of conventional pipe.

References

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