TU Delft

Offshore & Dredging Engineering

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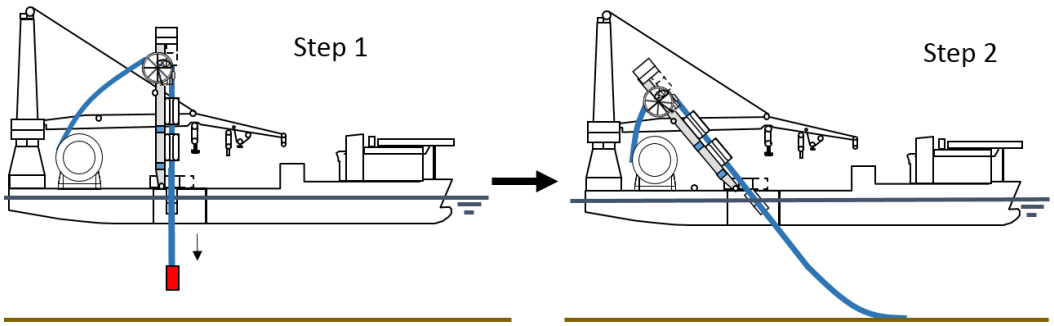
The onset of pipeline twist during reel-lay operations

Reel-lay operations in deep water with Heerema Marine Contractors' DCV Aegir show the onset of axial twist during pipeline lowering and lay operations. For both phases of the pipe lay, models have been made to approximate the twist observed during operations. The suspected instigators of pipeline twist that have been researched are: residual curvature in the pipeline after straightening operations, the plastic bending history of reeled pipelines, variable wall thickness along the pipeline due to the seamless pipeline fabrication and the effect of current during lowering. The main research however concerns the effect of residual curvature in the pipeline.



The twist development during pipeline lowering (step 1) has been modeled using analytically derived equations and by using Finite Element (FE) analysis. The pipeline lowering models with residual curvature give different twist values in comparison to actual measured data. As a result, extended research is done. The effect of a spiral wise wall thickness variation along the pipeline, which is known to occur in seamless pipes, is investigated. Using data from pipes tested by Heerema Marine Contractors, the results show that the aforementioned imperfection gives a negligible twist contribution during lowering operations.
Furthermore, the effect of current on the Pipeline End Terminal (PLET) is investigated. Qualitative static analysis show that a relatively low current speed on large pipeline lengths could give significant twist due to torsion: the lengthy pipelines offer less resistance to torsion. In house fluid body interaction research done on a modeled Flowline End Termination (FLET) shows comparative results.

For the investigation of the twist development during lay operations (step 2), again an analytical and a FE approach is used for modeling. The results show that residual curvature is the primary reason for twist during laying and that the direction of the residual curvature with respect to the lay direction is very important. Given Aegir's reel configuration, under straightened pipelines can give significant twist, whereas over straightening leads to negligible twist.

Although twist development during lowering is still unclear, the cause of twist during laying is understood and can be preventatively decreased. This can be done by either reducing the amount of residual curvature in the pipeline after straightening as much as possible or by keeping the residual curvature in the over straightening domain of the straightener.

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July 28th, 2016

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