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How Drillstring Rotation Affects Critical Buckling Load?

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Abstract

Buckling of tubulars inside wellbores has been the subject of many researches and articles in the past. However, these conservative theories have always followed the same assumptions : the wellbore has a perfect and unrealistic geometry (vertical, horizontal, deviated, curved), the friction and rotation effects are ignored, conditions relatively far from actual field conditions. How do tubulars buckle in actual field conditions, that is, in a naturally tortuous wellbore with friction and rotation? Can we apply theories developed for perfect well conditions (no tortuosity, no friction, no rotation) to actual well conditions?

For the first time, this paper presents how the drillstring rotation affects the critical buckling load in actual field conditions. These new results have been obtained from an advanced model dedicated to drillstring mechanics successfully validated with laboratory tests.

Firstly, this paper presents the new developments integrated in a recently advanced model for drillstring mechanics that enables to take into account the buckling phenomenon in any actual well trajectory. Indeed, some simultaneous torque-drag-buckling calculations are presented and allow to properly take into account the additional contact force generated in a post-buckling configuration, and as a consequence the additional torque at surface. Secondly, this paper shows the influence of friction and rotation on buckling loads for some practical and critical cases met in the drilling industry.

These friction and rotation effects are demonstrated with an experimental set up that enables to confirm theoretical features. Lastly, this paper shows that using standard buckling criteria may lead to too conservative solutions, and that under specific circumstances, the drilling and completion engineer could safely operate in a buckling mode for a given time. These new results presented in this paper should improve significantly well planning and operational procedures to drill and operate more and more complex wells.