Load case - lost returns with mud drop

Oliasoft

Abstract

In this document we describe the load case *Lost returns with mud drop* available in the Oliasoft™ application.

Introduction

Lost returns with mud drop is a collapse load case, where the unknown is the internal pressure profile of the tubing[1]. This load case reflects a sudden flow of mud into the formation at a *lost return depth*, resulting in a drop in mud level in the tubing and consequently a pressure drop.

Inputs The following inputs define the lost returns with mud drop load case

1) The true vertical depth (TVD) along the wellbore as a function of measured depth. Alternatively, the wellbore described by a set of survey stations, with complete information about measured depth, inclination, and azimuth.
2) The true vertical depth/TVD of
   a) The hanger of the tubing, $\mathrm{TVD}_{\mathrm{hanger}}$.
   b) The shoe of the tubing, $\mathrm{TVD}_{\mathrm{shoe}}$.
   c) The lost returns depth $\mathrm{TVD}_{\mathrm{LR}}$.
3) The pore pressure profile from hanger to shoe.
4) The mud weight/density, ρ_{mud}.
5) The atmospheric pressure, with default value $p_{\mathrm{atm}} = 101325\mathrm{Pa}$.

Calculations The internal pressure profile of the tubing is calculated as follows

1) Calculate the pore- pressure and density at the lost returns depth, $p_{\mathrm{p,\,LR}}$ and $\rho_{\mathrm{p,\,LR}}$, respectively.
2) Calculate the true vertical depth of the mud level,

$$\mathrm{TVD}_{\mathrm{mud}} = \left(1 - \frac{\rho_{\mathrm{p,\,LR}}}{\rho_{\mathrm{mud}}}\right)\mathrm{TVD}_{\mathrm{LR}}. \tag{1}$$

   The rationale behind this calculation is that the hydrostatic pressure of the lost mud should equal the pore pressure at the lost return depth.

3) The internal pressure profile in the tubing, parametrized by TVD, is given by

$$p_i = \begin{cases} p_{\mathrm{atm}}, & \mathrm{TVD} < \mathrm{TVD}_{\mathrm{mud}} \\ \mathrm{maximum}(p_{\mathrm{atm}}, p_{\mathrm{atm}} + p_{\mathrm{p,\,LR}} - \rho_{\mathrm{mud}}\, g\,(\mathrm{TVD}_{\mathrm{LR}} - \mathrm{TVD})), & \text{else,} \end{cases} \tag{2}$$

   where g is the gravitational constant.

[1] We denote any tubular by tubing. All calculations encompass both tubings and casings.