Content:

1 Case of Studies

The tensile forces at Horizontal Directional Drilling (HDD) depend on several criteria:

- Soil properties
- Diameter of the borehole
- Diameter of the pipe
- Length of the pipe

The Flexwell FHK is a flexible pipe with a helical corrugation. Thus, the tensile strength cannot be calculated with common statically calculations. Therefore, tensile tests shall prove that the Flexwell FHK endures the expected tensile force of the HDD.

2 Determining the yield strength

2.1 Strategy

BRUGG ROHRSYSTEME allows a plastic deformation of 1 % at the Flexwell FHK for each size. So it is necessary to execute tensile tests to determine the common RP 1 yield strength from a Stress-Strain-Diagramm. Therefore, three samples of the Flexwell FHK 200/310 will be tested at a certified and independent institute. This will be the FFI FERNWÄRME-FORSCHUNGSINSTITUT near Hanover.

The material quality certificates prove the material composition of the pipes. The internal QM proves the professional welding. All pieces will be taken off the same load. That is necessary because we need to verify the test-data statistically. That will not be successful, if there is a statistical deviation caused by different loads.

2.2 Installation

Each pipe is equipped with an HDD-head according to our catalog (FHK, S. 5.540, see Figure 1 below). One side is fixed, the other side will be pulled within a load cell (HBM, 200 kN, full-bridge type). The elongation will be detected over the whole experiment with an inductive distance transmitter (Micro-Epsilon, 200 mm). The independent and certified institute FFI (FERNWÄRMEINSTITUT HEMMINGEN) will execute these measurements. The certificate is attached.

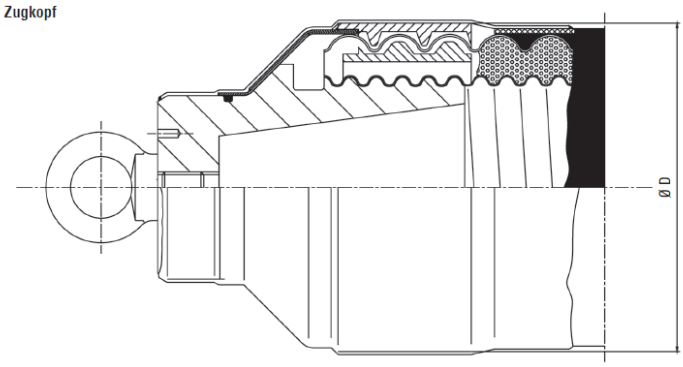

Figure 1: HDD-Head

The length of the tested pipes is 2 to 2,5 m and depends on the pipe size its elastic elongation. This is because the tension test unit has a maximum swing about 2,5 m.

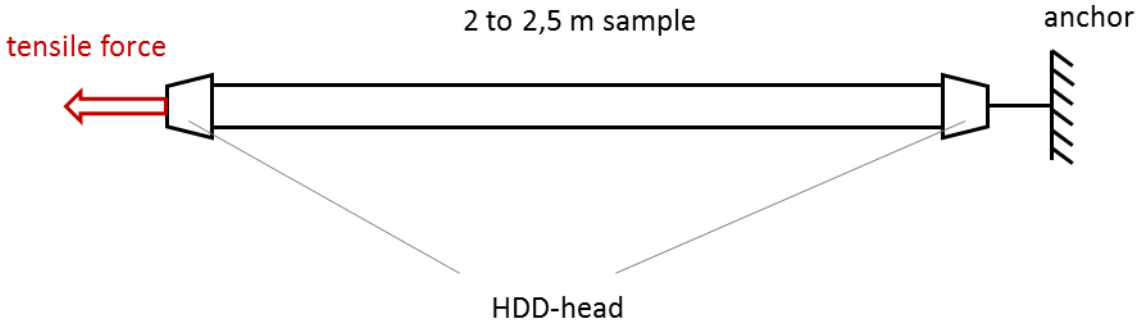

Figure 2: Schematic Installation to induce the tensile force

2.3 Execution

The tension test unit logs the force which is induced into the pipe. The elongation of the pipe will be logged too. Altogether, four experiments will be executed. The stress-strain-chart can be generated from these measurement data. For Flexwell FHK a permanent strain of 1 % (RP 1) is acceptable. The test is in dependence on DIN EN ISO 6892-1 (2017) TENSILE TESTING – PART 1: METHOD OF TEST AT ROOM TEMPERATURE. The strain will be increased constantly. The test will be conducted at ambient temperature, because the HDD will not cause high temperatures. The pipe system will be heated at initial operation the first time (long time after installation).

3 Evaluation of the yield strength

The stress-strain-chart illustrates the strength σ at the ordinate and the strain ε at the abscissa. The amount of RP 1 can be read off the diagram. The values of the strain of the base material will help to verify the experimental data qualitatively and to find out high deviation. They will not identify stochastic measuring faults. Therefore, the measured values will be evaluated statistically compared to [LERCH, ELEKTRISCHE MESSTECHNIK 2012]. These results will prove that the pipes will endure the pulling forces during HDD. A safety coefficient of 1,5 to 2 will ensure that the pipes endures the HDD without any damage. This coefficient is common for tensile loads. Finally, it depends on the standard deviation which is calculated off the analytical statistic.