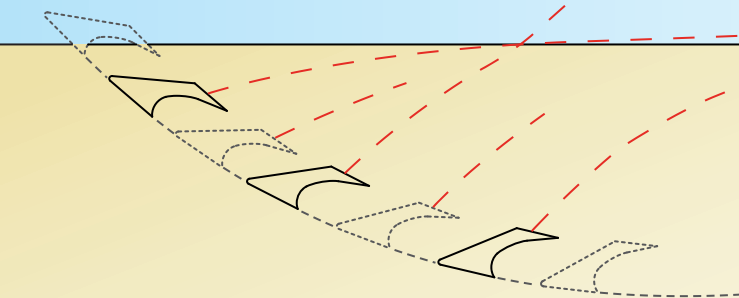
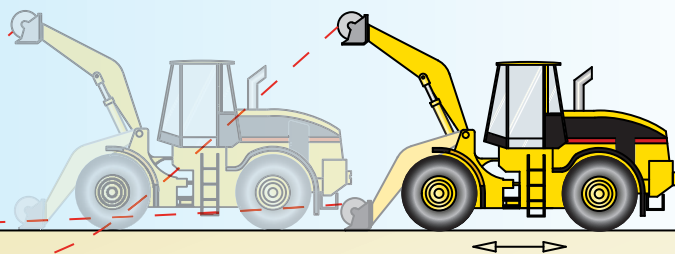


PROGRAM AND TEST PROCEDURE FOR FLUKE ANCHORS

Invitation to participate and contribute to comparative multi tests of drag-in plate and fluke anchors, aiming at safer and more cost effective mooring.



Offshore testing of anchors calls for huge resources, but the reliability of the test results is poor. Because of the uncertainties about the test conditions and soil data the results have been too crude for useful input data to advanced computer processing programs.

It really is very rare to find well documented anchor tests. The anchor tests performed by DNV on an onshore site in Norway 8-15 June 1998 (ref. paper OTC 10989) are up

to now the only (?) anchor tests with sufficient monitoring of test results for reliable input data to the advanced DNV DIGIN design program. Although these onshore tests are much less expensive than offshore testing it is still so complex and costly that no more of these tests have been performed in 10 years !!

A NEW APPROACH TO ANCHOR TESTING

The objective of this program is to design suitable field test equipment and test procedures for cost effective and reliable tests of drag-in plate and fluke anchors in well documented soils, obtaining accurate logging of test results for reliable input data to computer processing programs like the DNV DIGIN program.

The main field test equipment is a hydraulic winch with a pulling capacity of up to 30 tonnes and preferably using high performance synthetic winch rope for easy handling and light weight. The winch unit can easily be shipped to the selected test site, where it can be connected to a machine with lifting and moving capacity e.g. a heavy 4-wheel drive Caterpillar wheel loader (rented on site) to accomplish manoeuvring, and even hydraulically powering the winch. On soft soil, as when testing on a seabed when the tide is out, the 4-wheel drive machine can also use multiple mounted wheels. When using high pulling force it might be necessary to counter-anchor the Caterpillar. Suitable dimensions of chain or steel wire, related to anchor size, are used as forerunners to determine the influence on anchor behaviour.

For the soil investigation and for the logging and data acquisition of all test results, state of the art advanced measuring technique as well as simple manual measurements would be used.

This unique program and test procedure promote anchor tests with uplift angle from zero to 45 degree, which makes it possible to simulate even taut leg mooring configurations.

The test program proposes to start pulling the anchor in a zero to 20 degree uplift angle at a continuous speed up to the chosen installation load, which could be 10% to 50% of the anchors Ultimate Holding Capacity (UHC). Of course a closer to zero uplift angle gives a deeper penetration and higher UHC.

When the anchor is properly set, after being continuously pulled to a force in relation to anchor size, equal to available bollard pull in the offshore application, the uplift angle is changed to the preferred uplift angle for the chosen mooring configuration.

In the next phase the test program does not claim any specific pulling speed, so after changing to the preferred uplift angle, the test continues while still logging the time and all relevant test results, continuously correcting the uplift angle of choice until UHC are reached.

Utilizing this program and test procedure makes it possible, within reasonable costs, to perform so many anchor tests in different type of soils that the predictions of anchor behaviour, "without reasonable doubts", will be safer and more reliable than ever before.

More reliable tests will hopefully make it possible for the Classification Societies and Authorities to permit less bollard pull when installing the anchors, assured that the predicted UHC for the anchors will reach the target level and even withstand the ultimate 100 year storm if and when it arise.

The test program will certainly make it easier to choose the right type and size of anchor for a specific location, and even render huge savings in mooring costs.

The invitation to participate and contribute to this important test program goes to: Oil Companies, Anchor Manufacturers, Engineering Companies, Marine Mooring Consultants, National Authorities and Classification Societies. The budget has no limit, but sponsorship for funding, consulting or practical contributions would all be appreciated.

The intention is to invite Det Norske Veritas to participate in the detailed specifications for the individual test programs, and identification of essential needs for more test results for input data to the DIGIN program in order to analyse anchor behaviour in different soils and mooring configurations.

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