

## DIGITAL SOLUTIONS

# SESAM™

## Helica

### Cross-section analysis

What characterizes flexible pipes, umbilicals and power cables is a multi-layered cross-section containing helixshaped components. The helix construction is what makes the products flexible in bending, but this feature comes at a cost; calculating mechanical properties and component stresses are not straight forward.

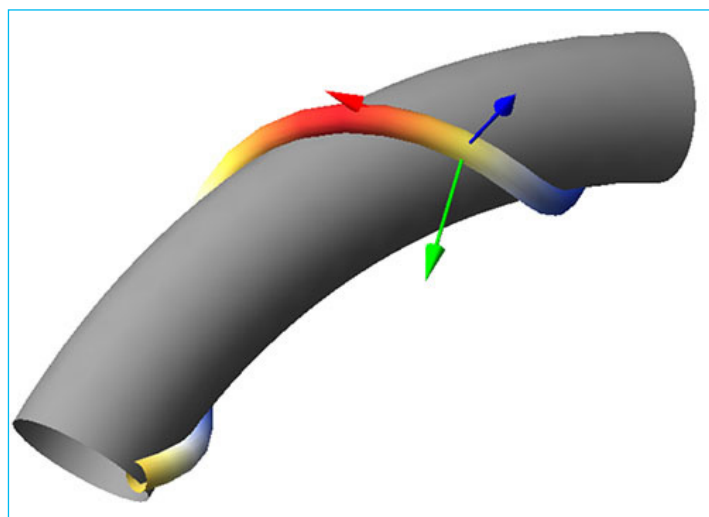
#### What is Helica?

DNV GL's Helica software is a stress analysis tool that is tailor made for cross-section analysis of flexible pipes, umbilicals and power cables. The ingenuity of Helica is its mathematical engine that facilitates highly efficient fatigue analysis consistent with the global response determined through dynamic analysis.

#### What can Helica do for you?

Helica calculates:

- Mechanical properties, including stick and slip bending
- Stiffness and angle of twist as a function of tension
- Load share
- Allowable tension vs. curvature/ capacity curves
- Component stresses due to combined loading, accounting for
- Inter-layer contact (due to tension and internal/ external pressure, radial deformation) and stick/ slip effects
- Short-term fatigue damage
- Long-term fatigue



### Computational efficiency

Helica supports parallel processing, making the analysis process extremely efficient, as illustrated by use of a standard single core lap top from 2008:

- 270 time domain simulations of 1 hour duration, each of 20 000 time steps
- Fatigue damage calculated at 4 hot spots and 76 locations along the riser
- 985 000 stress time series / 20 billion fatigue stress calculations

Computation time: 5.8 hours in total / 77 seconds per sea state.

### Extreme load capacity checks

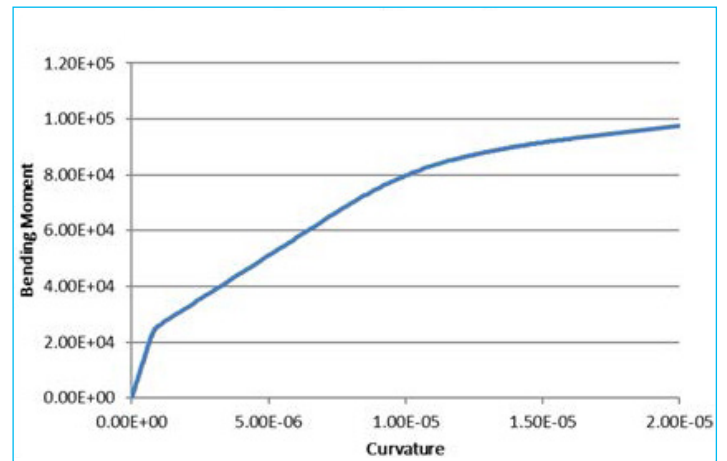
Helica performs extreme load capacity checks in accordance with ISO 13628-5, by importing results directly from global analysis, calculating utilization time series, and plotting this against the relevant capacity curve. Capacity curves can be calculated by Helica or imported. Helica also reports statistical extreme utilization based on the utilization time series.

### Fatigue analysis

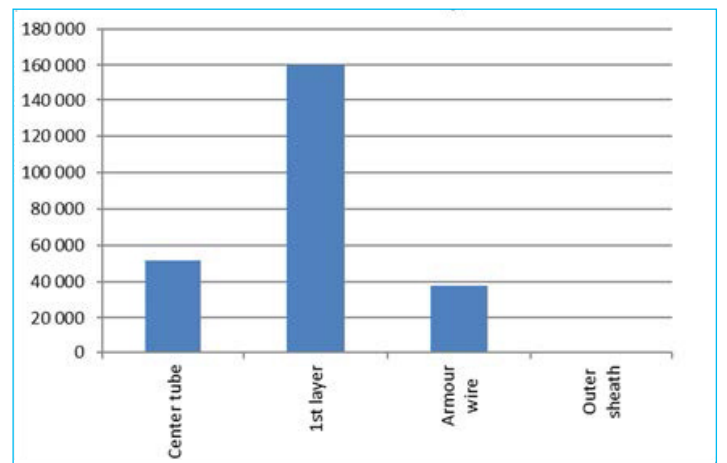
Helica performs short-term fatigue analysis based on histograms or time series imported directly from global analysis performed in Reflex, Orcaflex and Flexcom. The number of helix hot spots and what riser sections to consider, e.g. in the bend stiffener and/ or touchdown regions, are specified by the user. Long-term fatigue damage is then calculated by accumulating damage over all load conditions and directions. Additional load conditions are easily analysed and considered in the accumulated damage.

### Helica validation

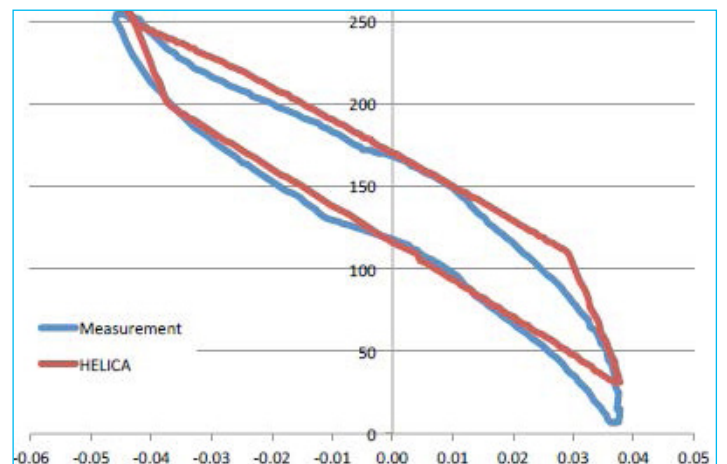
A joint industry project was recently run together with Ultra Deep and ExxonMobil to validate Helica against full-scale tests. Results from Helica were compared to high quality stress measurements in umbilicals subjected to combined tension and bending. And as the figure on the right illustrates, the correlation was outstanding! No adjustments to the input or the software were made.



Cross-section bending performance



Axial force in layers



Validation of stress analysis