Guidance Note : Free Span Analysis

UMF – GN04

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Umbilical Manufacturers' Federation
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Purpose

The purpose of this Guidance Note is to describe the typical process when conducting free span analysis on umbilicals.

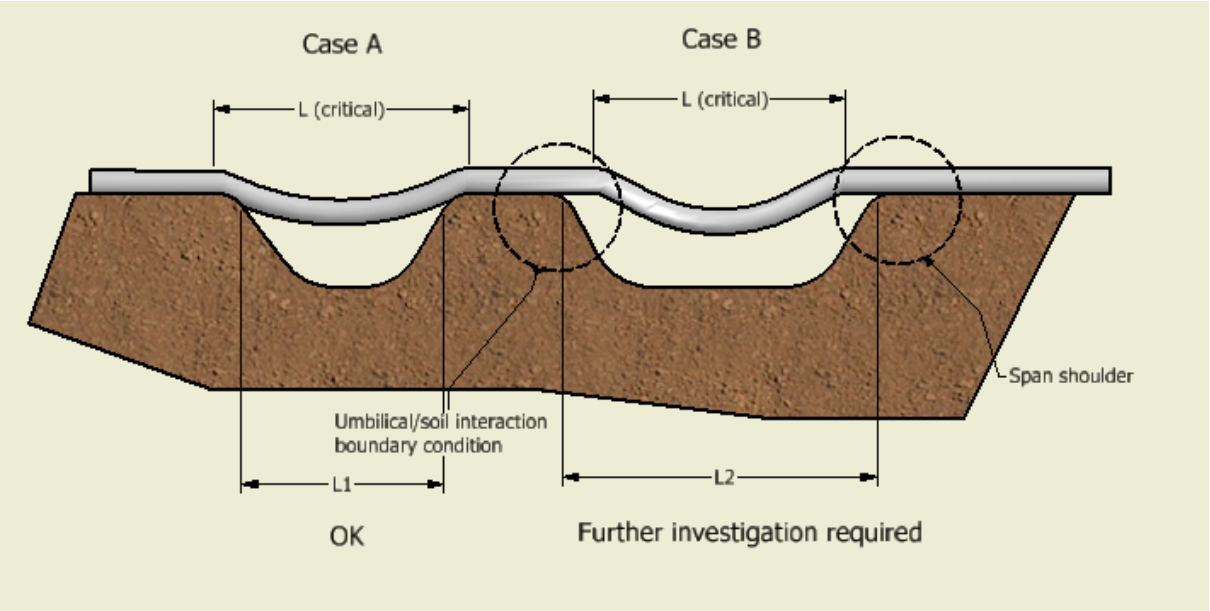
References

DNV RP F105
UMF document: "UMF – GN02, Glossary of Terms and Abbreviated Terms for use with Umbilical Systems"

Free-Span Analysis Definition

This section defines typically what free span and free span analysis involves, and also how they specifically relate to umbilical designs. Typically DNV RP F105 is used for free span analysis. The term 'free span' is used to refer to the scenario whereby a section of static umbilical is unsupported along its length for a distance, typically greater than 3m.

If the lay route includes free spans longer than the critical length then the umbilical may be subject to Vortex Induced Vibration (VIV) possibly leading to one or more of the following: fatigue, wear, curvature and infringement of local structural capacity at span shoulder.



The reasons for the umbilical being unsupported can be various, e.g. local seabed topology, scouring of the soil from underneath the umbilical, the physical configuration of the subsea terminations, spans between I-tube and seabed, and at pipeline crossings.

Umbilicals are significantly less sensitive to the effects of free span compared with rigid pipelines. The reasons are:

- The smaller relative diameter of the umbilical
- The lower bending and axial stiffness of umbilicals compared with pipelines
- Umbilical structural damping characteristics are significantly greater than rigid pipelines

Free Span Analysis Process

For any given umbilical and environment there will be a critical length below which the effects of free span can be ignored and above this critical length, the effects should be analyzed. At the critical length or greater, the umbilical may be affected by environmental loads and VIV fatigue loading.

Typical analysis parameters that can affect the maximum allowable length include:

- Umbilical outer diameter, mass, bend stiffness and fatigue performance
- Current velocity
- Residual umbilical lay tension
- Boundary conditions at each span shoulder should adequately replicate the umbilical soil interaction and the continuity of the umbilical
- Seabed conditions

Analysis is typically performed using purpose made software to determine the maximum length based on allowable fatigue life and confirmation that curvature and structural loads have not been exceeded. The allowable span lengths are found for a range of lay tensions.

If these values are smaller than the required installed spans, the following input parameters can be modified to produce overall acceptable results:

- Modify lay route direction
- Seabed intervention e.g. rock dumping
- Umbilical design change

Free span analysis requires the following types of information to allow the analysis to be conducted:

- Specification of the required return period(s)
- Bottom current profile, direction and long time distributions of these
- Wave spectrum and water depth
- Soil data
- Lay tension (upper and lower bound)
- Crossings, I-Tube or termination to seabed geometry (where applicable)
- Umbilical lay route
- Umbilical diameter, mass, bending and axial stiffness and structural damping co-efficient
- Marine growth
- Boundary condition
- Bend restrictor data

- Design life
- If applicable: trench geometry; depth and exposure time without trenching