

Fugro Engineers SA/NV



COMPANY PROFILE

Fugro Engineers SA/NV (FESA) offers specialised consultancy services worldwide to clients and sister companies in the Geotechnical Division, on land, nearshore and offshore. A particular expertise includes the development and commercialisation of the proprietary market leader pipeline analysis software packages, SAGE Profile.



Pipeline analysis software, SAGE Profile 3D

SERVICES AND CAPABILITIES

FESA employs a team of highly qualified (MSc and PhD's level) geotechnical engineers with substantial experience in both onshore and offshore projects. FESA's staff has expertise in:

- Onshore and offshore foundation design
- Embankment dam and slope stability analysis
- LNG tank foundation design
- Pipeline/cable burial assessment
- Pipeline engineering
- Soil improvement and reinforcement
- Finite element analysis
- Engineering software development
- Geotechnical site investigation supervision

The company management system is accredited ISO 9001:2000 (Quality Management System) and OHSAS 18001 (Health and Safety Management System).

ONSHORE AND OFFSHORE FOUNDATION DESIGN

FESA provides consultancy services for the design and construction of onshore and offshore facilities.

Onshore and offshore foundation engineering and design services include:

- Selection of foundation design parameters
- Pile design including pile capacity and performance
- Pile installation studies
- Pile group analysis
- Sub-sea production system foundation design (including suction caissons)
- Temporary foundation (mudmat) design
- Shallow foundation design
- Jack-up sitting studies
- Anchor design
- Settlement analysis
- Design of settlement reducing piled raft



Foundation Northsea windfarm

EMBANKMENT DAM AND SLOPE STABILITY

FESA provides consultancy services supporting the design and construction of embankment dams and in projects involving slope stability problems.

Capabilities include:

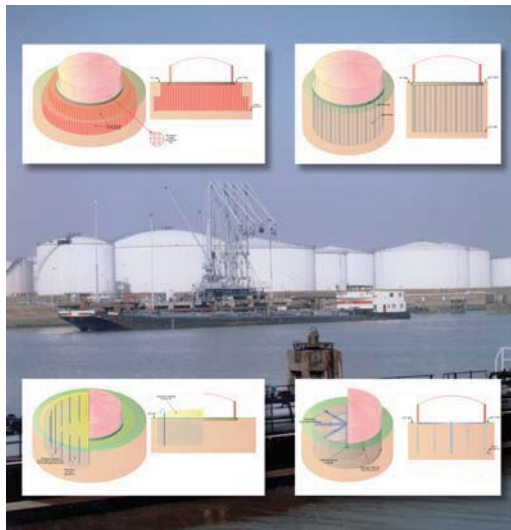
- Slope gradient optimisation
- Seismic slope stability, including assessment of seismically induced displacements, risk of liquefaction and post-earthquake stability
- Slope and embankment reinforcement
- Slope failure back-analysis
- Slope stabilisation and repair
- Consolidation and settlement analysis
- Design of monitoring systems
- Site investigation specifications definition
- Selection of design parameters for natural soils and artificial soils such as tailings

LNG TANK FOUNDATION DESIGN

Since 2000, FESA has been involved in several LNG tank foundation design projects.

Capabilities include:

- Selection of foundation design parameters
- Tank foundation design, including design optimisation
- Settlement analysis
- Soil improvement techniques to minimise settlement



Foundation LNG tanks



Construction embankment dam

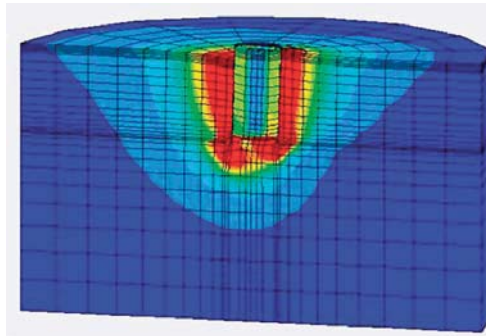
BURIAL ASSESSMENT

Fugro is a specialist in offshore pipeline/cable route survey and burial assessment. FESA maintains a database of pipeline/cable trenching ploughs and jetting systems. Over the years, FESA has developed models of plough performance which relate tow tension, burial depth and progress rate to soil properties. FESA has back analysed thousands of kilometres of pipeline/cable installation. Our database has been used to fine-tune performance analysis models for ploughs and jetting systems.

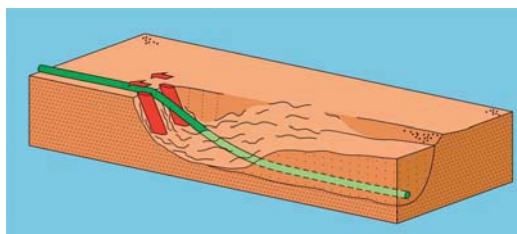


These models and the associated geological, geophysical and geotechnical engineering expertise enable FESA to provide reliable burial predictions for specific or generic ploughs or jet trenchers. Expertise covers the following topics:

- Geophysical and geotechnical data integration
- Development of plough performance prediction models
- Development of jet-trencher models, including small scale testing
- Cable burial assessment
- Pipeline trenching assessment
- Risk assessment during trenching and backfilling.



ABAQUS model of a suction anchor



Burial assessment - Jet trencher model

OFFSHORE PIPELINE ENGINEERING

FESA provides consultancy services for the installation of pipelines. Our pipeline consultancy services cover a range of analyses including:

- Pipeline route selection
- Pipeline soil-interaction
- Out-of-straightness analysis
- Span prediction
- Span check using latest DNV code
- Plough pick-up analysis
- Fatigue analysis
- Pre-sweeping analysis
- Upheaval and lateral buckling assessment, including rock dump optimisation

Most of these analyses can be performed using in-house developed software SAGE Profile.

FINITE ELEMENT ANALYSES

FESA can perform finite elements analyses to model complex geotechnical problems related to soil-structure interaction, including 2D/3D consolidation analyses. Current finite element software packages include:

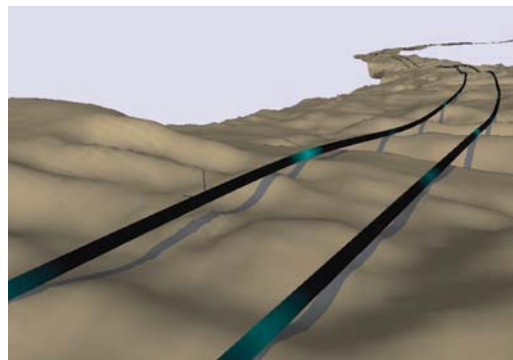
- SAGE Profile 2D/3D: finite element program for pipeline analysis
- PLAXIS 2D/3D: finite element code for soil and rock analyses
- ABAQUS 2D/3D: general-purpose nonlinear finite element software

ENGINEERING SOFTWARE DEVELOPMENT

FESA develops and commercialises SAGE Profile 2D and SAGE Profile 3D, two finite element programs for pipeline analysis. The following supporting services are provided:

- Customer technical support
- Provision of training courses
- Consultancy services using SAGE Profile

In addition, FESA is developing software for the Fugro group. Software can be divided into three groups: data processing (e.g. SMARTPIPE® processing software); engineering analysis; and cable modelling (e.g. real time mooring line simulation module for the Survey division).

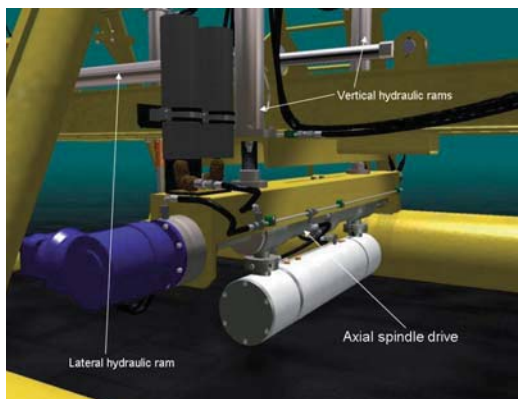


SAGE Profile 3D pipeline analysis

ADVANCED CONSULTANCY SERVICES

FESA consultancy services cover a wide range of fields related to onshore, nearshore and offshore geotechnical engineering. Thanks to a team of highly qualified geotechnical engineers, FESA expertise is recognised worldwide. FESA has been involved in high profile engineering projects, such as the foundation design in very weak soil, creep induced settlement, determination of pipeline uplift resistance in loose liquefying sand, and the SMARTPIPE® development (in-situ soil-pipe interaction measurement system for deep water flowlines).





FUGRO SMARTPIPE®
for in-situ soil-pipe interaction measurement

SITE SUPERVISION

FESA engineers are well qualified to actively participate in geotechnical site investigations on- and offshore. They are involved at different levels, working together with other Fugro Offshore Geotechnics' teams on board survey vessels. FESA also has experience managing onshore site investigations carried out by another OPCO and supervising laboratory testing.



Site supervision

FUGRO GROUP PROFILE

The Fugro group of companies collects and interprets data related to the earth's surface and the soils and rocks beneath. Based on the results, it provides advice generally for the oil and gas industry, the mining industry and the construction industry. Fugro's professional, high-specialised staff operates around the world on land, at sea and in the air using advanced technology, data gathering equipment and systems, many of which have been developed in-house.

Fugro's clients operate in wide-spread locations and under diverse conditions. To best meet their clients' needs, Fugro's organisational structure is decentralised and market-oriented.

Fugro holds a leading and unique market position due to its (in-house) technological developments, high-value services provision and strong international footprint. Fugro was founded in 1962, has been listed on Euronext N.V. in Amsterdam since 1992 and has been included in the Amsterdam Midkap-index since March 2002. Fugro has approximately 13,000 employees stationed in over fifty countries.

Organisationally Fugro comprises three divisions:

GEOTECHNICAL SERVICES

Investigation of and advice regarding the physical characteristics of the soil and materials for construction.

SURVEY SERVICES

Precise positioning, topographic, hydrographic and geological mapping; support services for construction projects and geological advice; geo-spatial data management services.

GEOSCIENCE SERVICES

Gathering and interpretation of geophysical data; quantitative and qualitative estimates of oil, gas mineral and water sources; and the optimisation of their production.

Fugro Engineers SA/NV
Avenue de Broqueville 12
1150 Brussels
Belgium
Tel.: +32 2 776 0310
e-mail: info@fugro.be
www.fugro.be

