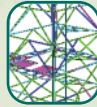




SAFI™ Oil & Gas

PSE PETROLEUM STRUCTURAL ENGINEERING SOFTWARE: OFFSHORE & ONSHORE

Company history

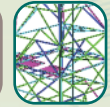


SAFI Quality Software Inc. is a software research and development company, headquartered in Canada and founded in 1986 by CEO Dr. Rachik Elmaraghy, Eng., Ph.D. The R&D team comprises senior structural engineers and computer science specialists.

The company's R&D efforts are directed primarily towards the total integration of its innovative state-of-the-art structural engineering technology. The structural applications offered cover most of the structural fields in civil engineering and are adapted to various international standards and unit systems. The technology addresses structural analysis, verification, evaluation, rehabilitation, design, detailing as well as drafting, fabrication and estimation.

The company's main objective is to ensure that the end users are productive by providing them with reliable, up to date and simple to use technologies.

Overview



The PSE Petroleum Structural Engineering software is used for the design and rehabilitation of drilling structures for the offshore and onshore industries, including drilling masts, derricks and substructures. The software accounts for wind loads, vessel dynamic motions, wave and current loads.

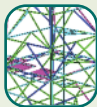
Wind loads, based on the velocity component approach, and vessel dynamic motions are defined according to API 4F Specification for Drilling and Well Servicing Structures (3rd edition).

The inertial forces due to the vessel dynamic motion as well as radial, tangential and translational forces due to the acceleration of masses attached to the drilling structures have a significant influence on design and reliability.

Wave loads and current generated forces applied to submerged structural members in platforms and floating hulls are analyzed through linear and nonlinear kinematics in accordance with the API RP 2A specifications.

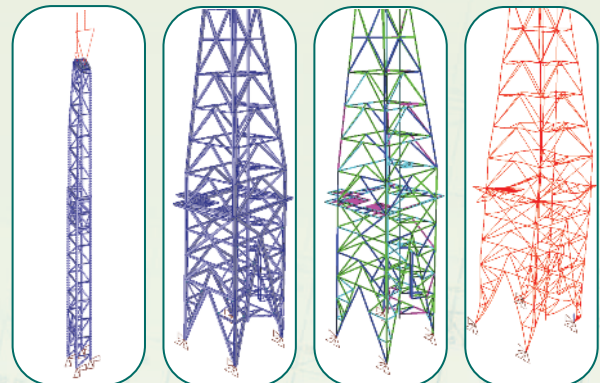
Other loads such as seismic, snow and ice loads for far northern extreme weather are also considered for the design of masts, derricks, platforms and substructures.

Technology for the Offshore-Onshore industry:



The PSE Petroleum Structural Engineering software is the engineering tool for the offshore and onshore industries. It is also the engineering engine of the VPS Virtual Petroleum Structures new technology for offshore and onshore structures. Through its multiple views, the VPS allows to carry engineering work, connection and weld design as well as extraction of detail drawings and fabrication data from a unique database. With the VPS new technology, there is no need to use transfer protocols, nor to repeat model generation in the various phases of a project.

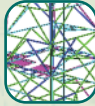
Engineering services and training are offered through StructureTech Network Inc., SAFI's sister company.



Offshore and Onshore Customers: A number of prestigious companies are using the SAFI "PSE Petroleum Structural Engineering" Software for their production project work and have built innovative offshore and onshore derricks, masts and sub structures. Among these organizations are Mastco Derrick Services Ltd., Empire International Service Rigs Inc., Lakota Drilling a Savanna Energy Services Company, Precision Drilling Corporation, Oil Country Engineering Services Ltd. and other major international companies.



**Offshore Vessel
Dynamic motions:**



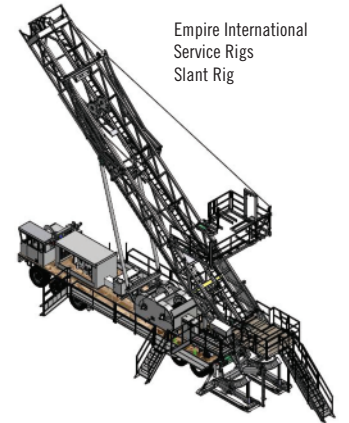
In various production wells, the offshore drilling structures are located on top decks of vessels, semisubmersible or floating hulls. Vessel motion includes roll, pitch and yaw rotations and heave, sway and surge translations.

The PSE software computes the inertial forces due to the vessel dynamic motion as well as radial, tangential and translational forces due to the acceleration of masses attached to the drilling structures. These forces have a significant influence on the structural design and reliability of offshore structures.

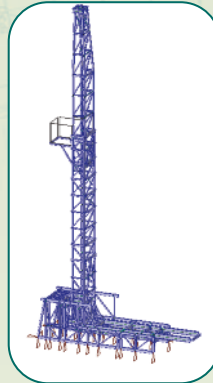
High pressure mud piping, electrical cable trays, junction boxes, racking boards, tong counterweights, turning sheaves, deadline anchors, crown accessories, casing stabbing baskets and other outfitting items add weight to the derrick. Weight data is converted to masses applied at the correct locations on the derrick.

The PSE software accepts three types of user input in order to estimate the inertial forces induced by the vessel dynamic motions:

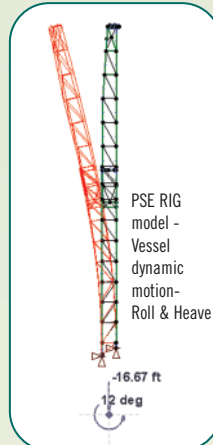
- Linear displacements, angular rotations and time periods
- Linear and angular velocities and accelerations
- Linear accelerations at two points in the vessel which are converted to linear and angular accelerations by the program



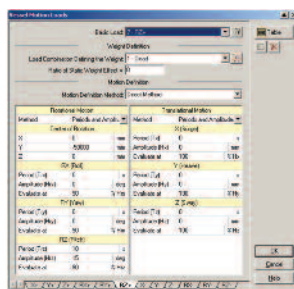
Empire International Service Rigs Slant Rig



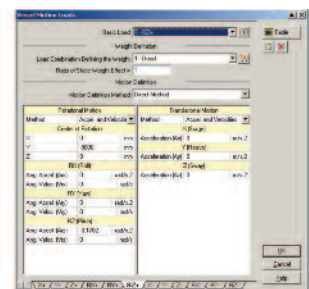
Empire International Service Rigs Vertical Rig



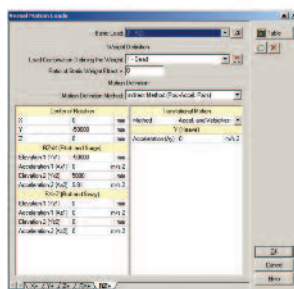
PSE RIG model - Vessel dynamic motion - Roll & Heave



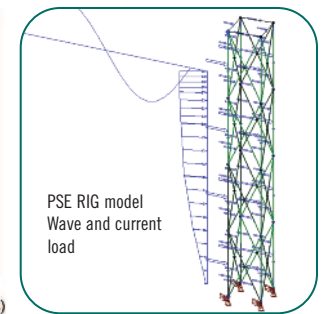
Direct Method (Periods and Amplitudes)



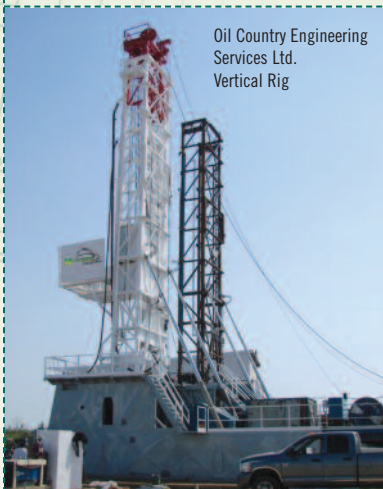
Direct Method (Accelerations and Velocities)



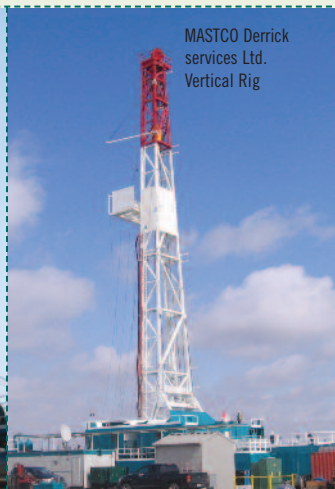
Indirect Method (Elevation-Acceleration Pairs)



PSE RIG model Wave and current load



Oil Country Engineering Services Ltd. Vertical Rig

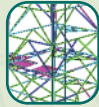


MASTCO Derrick services Ltd. Vertical Rig



Wave

and Current Loads:



The PSE software computes wave and current forces applied on the structural members. The wave kinematics can be established using either Airy's linear theory or Fenton's nonlinear theory.

The linear kinematic theory is valid where the wave height is small compared to the water depth. On the other hand, the non-linear kinematic theory, proposed by J.D. Fenton, solves the motion equations by representing the velocity potential and surface elevation with a Fourier series. The later method minimizes the error of each parameter governing the wave motion equations and is valid over the entire spectrum.

The PSE software accounts for the following wave profiles and kinematic parameters:

- Wave period
- Incidence angle
- Elevation of the sea bed
- Elevation of the still water line (SWL)
- Kinematic reduction factor
- Crest position criterion

Preview of the wave surface profiles, velocities and accelerations at any point is readily available.

With the PSE software, the current profile is described with respect to the sea bed. The current speed is defined by a set of elevation-velocity-angle triplets and the reduction of the current speed in the vicinity of the structure or the blockage factor is accounted for.

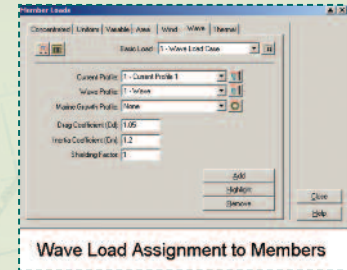
In order to combine the current with the wave profile, the current needs to be stretched, or compressed, to the local wave surface. Two stretching methods are available:

- The linear stretching method, also known as the Wheeler stretching
- The non linear method, or hyperbolic stretching

According to commentary C.3.2.1 of the design code API RP-2A-2003, the Doppler effect is accounted for by calculating an apparent period defined as the wave period as seen by an observer moving with the current.

Marine growth increases the cross section diameter and surface roughness of the members, and it is defined by a set of elevation-thickness pairs.

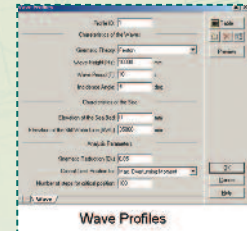
SAFI, simply reliable since 1986



Wave Load Assignment to Members

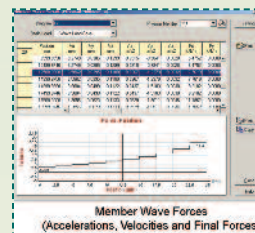
The input for the member wave loads consists of the following six parameters:

- Current profile
- Wave profile
- Marine growth profile
- Drag coefficient
- Inertia coefficient
- Shielding factor

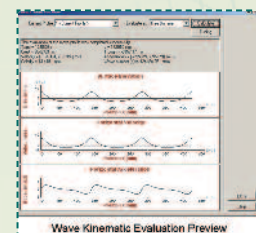


Wave Profiles

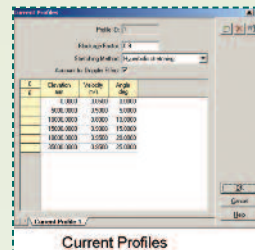
The member forces, calculated using Morison equation, vary according to the position of the waves with respect to the structure. In order to obtain the maximum forces in the members, the critical position of the wave crest is determined by the program.



Member Wave Forces (Accelerations, Velocities and Final Forces)



Wave Kinematic Evaluation Preview



Current Profiles



Marine Growth Profiles

PSE USER Comments:

SAFI's PSE Petroleum Structural Engineering software has been used by several notable international companies in production work for building innovative offshore and onshore derricks, masts and substructures. The following is a partial customer list:

- Mastco Derrick Services Ltd.
- Empire International Service Rigs Inc.
- Lakota Drilling, a Savanna Energy Services Company
- Precision Drilling Corporation
- Oil Country Engineering Services Ltd.