PRESENTATION

NAIAD

What it is

Analytics **quantify the physics underlying the actual, time-dependent behaviour of a system under loads and constraints**

The modeling resolves the interplay of all couplings arising from the reality of the operation, and simultaneously solve all relevant phenomena. The result: a quantification of a system's true reactions. That quantification cannot be achieved from code-sequenced empirical formulae and fudge factors; one must solve the entire geometry under consideration, *without simplifications to loads, constraints, material behavior or geometric cardinality.*

Computational Mechanics

- Structural
- Dynamic
- Thermal
- Coupled structural/mechanical/thermal
- Explicit modelling (impact, explosion, shocks).

Computational Materials

- Linear and non-linear materials
- Plastics and composites
- Viscoelasticity and hyperelasticity
- Fatigue and creep
- Crack formation and propagation.

Computational Electromagnetic

- Electrostatic and magneto static
- LF and HF electromagnetic radiation
- LF and HF electric systems
- Current induction and conduction
- Circuit analysis and coupling
- Ion optics, charged particles, plasma flows

Computational Fluid Dynamics (CFD)

- Steady, transient, cyclic and shock flows
- Newtonian and non-Newtonian flows
- Multiphase, porous media and particle flows
- Reactive, combustive, and species modeling
- Acoustic, pulsations and vibration
- Plasma and magneto hydrodynamic flows
- Dynamic, moving & deforming, and rotating meshes
- Convection, conduction and radiation heat transfer
- Atmospheric emission, diffusion and dispersion
- Mixing, separation and filtration
- Underground and reservoir modeling

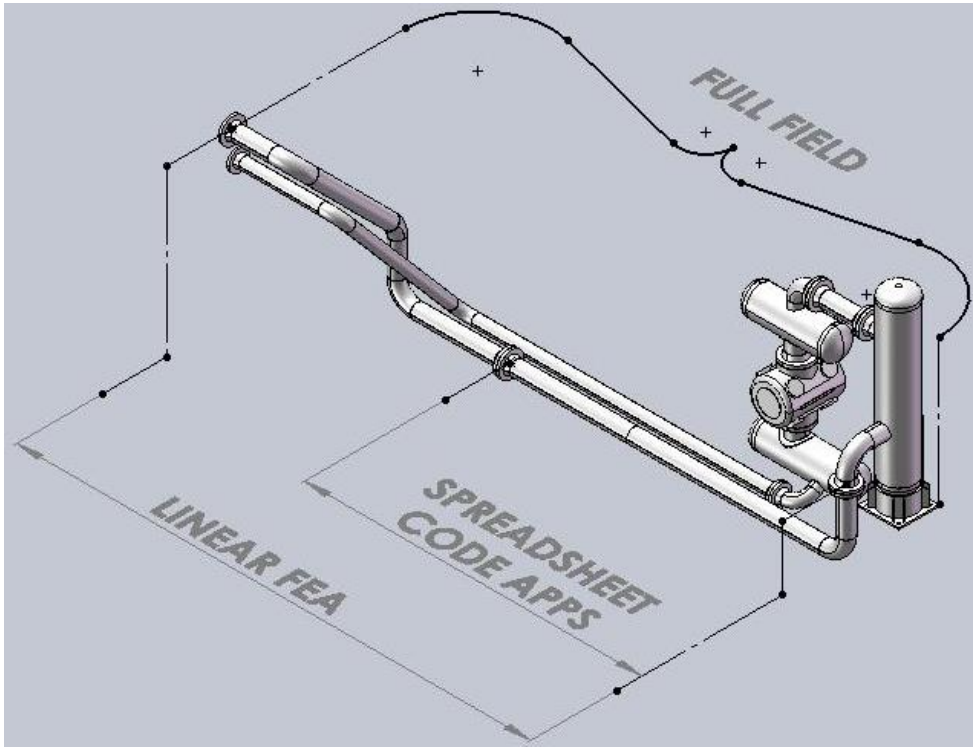
Computational Multi-physics

- Acoustic-structural
- Electric-magnetic
- Fluid-structural/thermal/electromagnetic
- Magnetic-structural, magnetic-thermal
- Piezoelectric and piezoresistive
- Structural/thermal/emag

What it is not

It is not a pre-packaged, canned software that regurgitates the design cases, equations, tables and fudge factors enshrined in the likes of ASME and API standards.

Spreadsheets / Code App	Analytics
Single point values	Full field quantification of entire geometry
Sequential calculation recipe based on empirical formulae and correction factors	Simultaneous solution of the systems of partial differential equations defining the physics at play
Idealized, simplified, linearized models based assuming homogeneous, isentropic, de-coupled variables under steady state static loads	Non-linear, plastic/elastic, multivariate multi-physics (stress, heat, fluids, kinematic, dynamic) models
No torsion, no out-of-plane strains, static loads, no friction or contact or coupled deformations, stress only	All physics, all load types, all load cycles, all non-linearities



Asset Integrity Engineering (AIE)

NAIAD's AIE assists Clients in maximizing their capital investment. AIE is an integrated problem solving methodology for field installation problems.

Aerial coolers
Compressors
Cooling tower
Dehydration
Expanders
Fired equipment
Flare stacks
Fractionation & absorption
Foundations and skids
Heat exchangers
Heat recovery
HVAC systems
Hydrocarbon treating
Incinerators
Manifolded pipe flows
Piping and pipelines
Pressure vessels
Prime movers
Pumps & Turbines
Refrigeration
Relief systems
Rotating equipment
Separators & filters
Storage tanks
Sulfur recovery
Water treating

Facilities will suffer, over time, defects, performance degradations and failures that will threaten, in turn, their safety, reliability or productivity.

These issues require sophisticated tools, processes and skills that lie beyond the realm of code-based equations, spreadsheets and template calculations

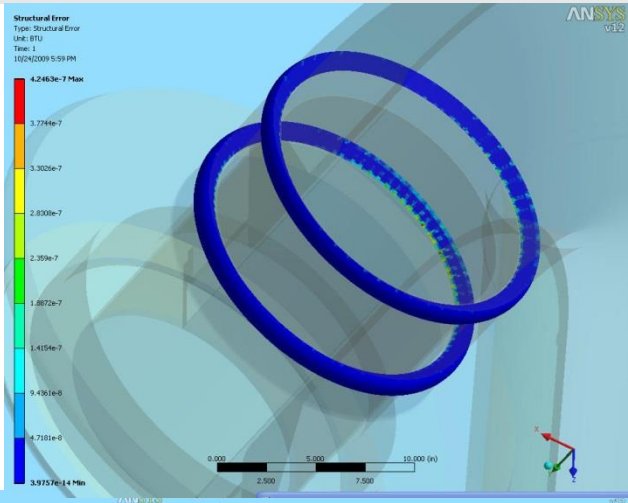
Target codes

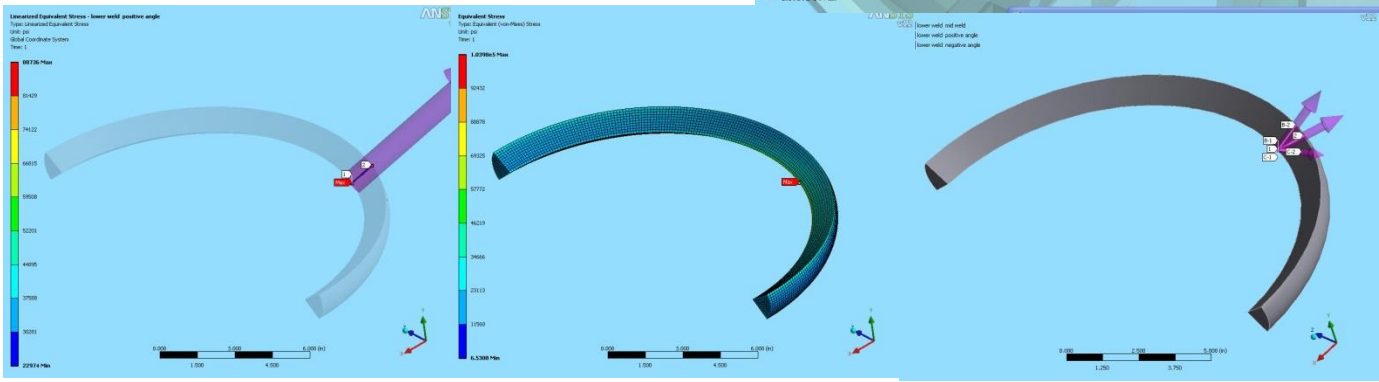
API 11P, 520, 521, 579, 610, 618, 619, 671, 684

ASME BPV Code Section 8, Div 1 and 2

ASME B31.1 and 31.3

CSA z662





Orientation of stress classification lines in circumferential direction relative to max equivalent root stress

API Studies

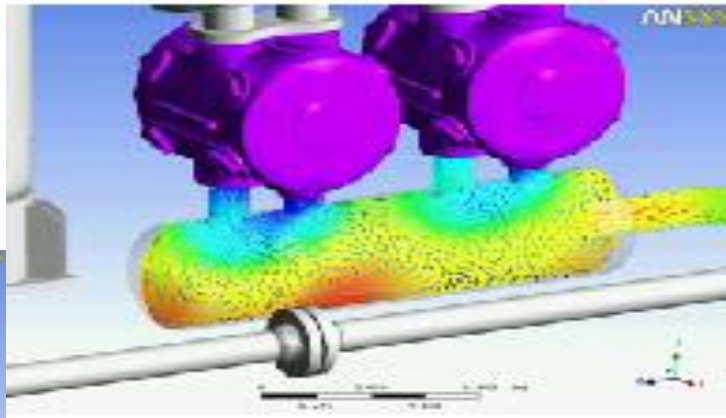
API 520, 521, 570, 610, 617, 618, 619, 684

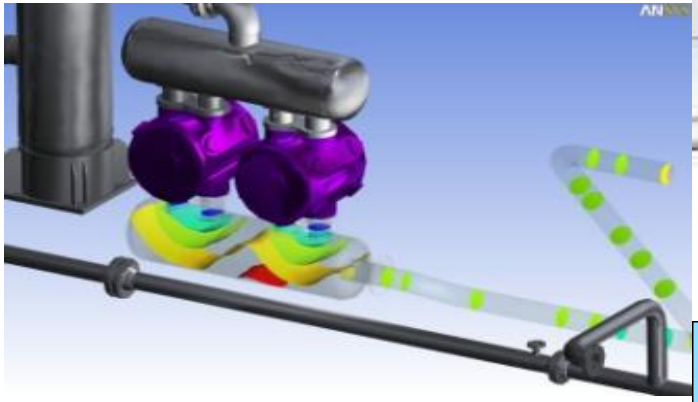
Rotating equipment

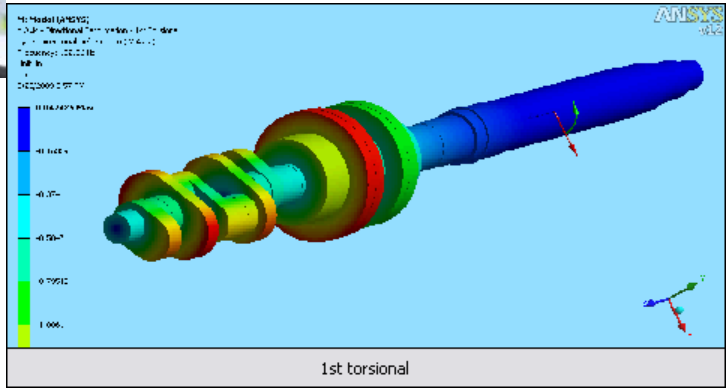
- Pulsation analysis
- Vibration analysis
- Torsional analysis
- Pressure vessels
- Piping systems
- Skid, cranes, lifting
- Cover & flange design
- Coupling & flywheel design
- Foundation design

Flares, incinerators and drums

- Sizing, design, engineering
- Dispersion and combustion modeling
- PSV release event modeling





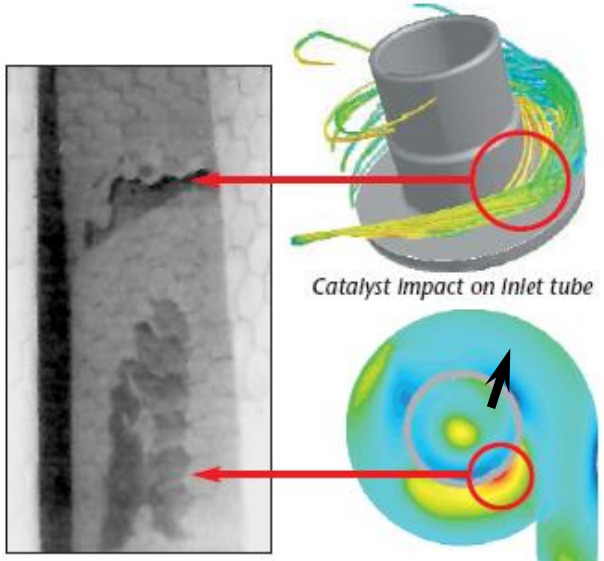


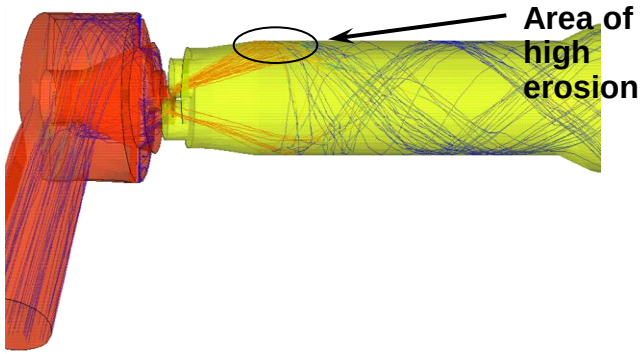
1st torsional

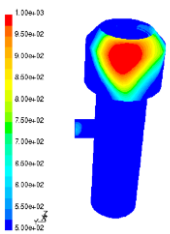
Simulation modeling is carried out in 4D full field to quantify the actual, coupled behaviour of an entire system under real loading conditions, without simplifications of the geometry or physics at play. Compliance to the applicable code(s) automatically emerges from the results, rather than be worked into the model.

Capability examples

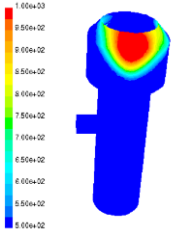
Flow-induced erosion – Flare behaviour





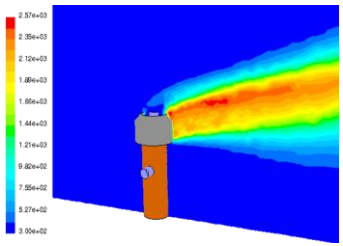


Fuel to Wind ratio 1:2



Fuel to Wind ratio 2:1

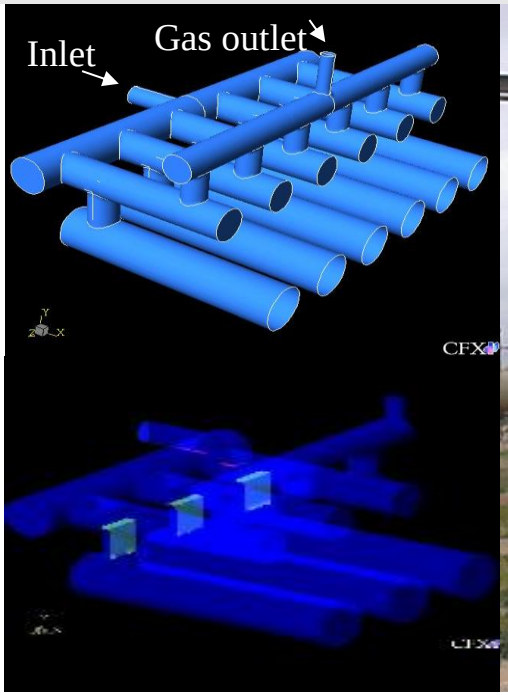
Flame shape and shroud surface temperature for two different fuel and wind ratios



Particle trajectories, colored by velocity and associated erosion area, for two shocks

Capability examples

Offshore structure – wind and wave loadings, Multi-vessel slug catcher

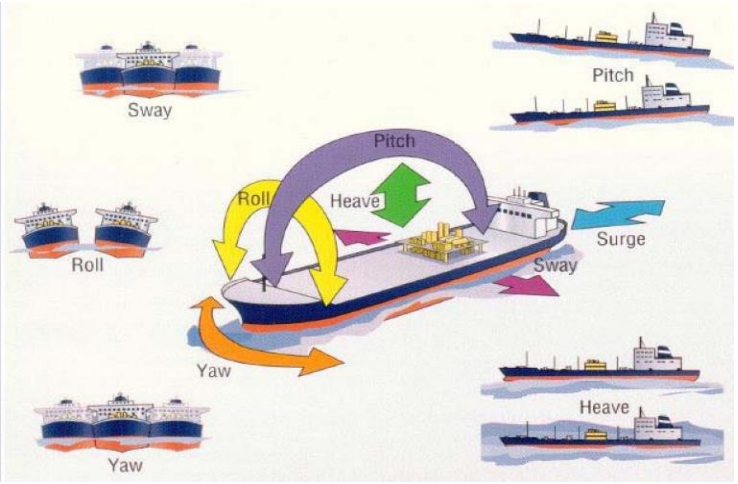


Transient pressure distribution caused by ocean waves on an shallow water platform

Animation of liquid volume fraction of slug catcher at maximum capacity and the corresponding carry over plot on the right (Hannibal Terminal, UK)

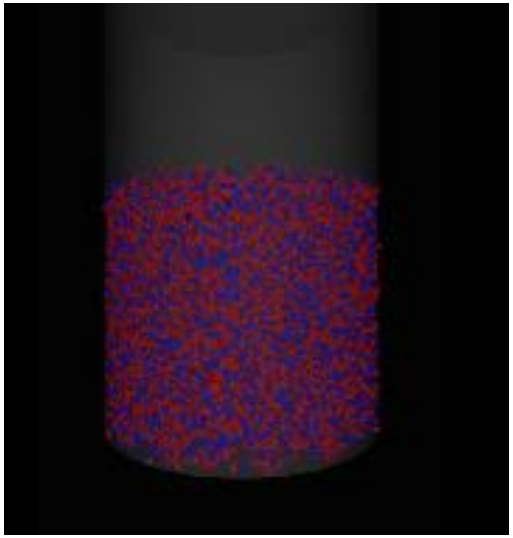
Capability examples

Sloshing separator design, Solid separation, particle convective diffusion



Simulated effect of baffles in reducing sloshing in a oil-water-gas separator

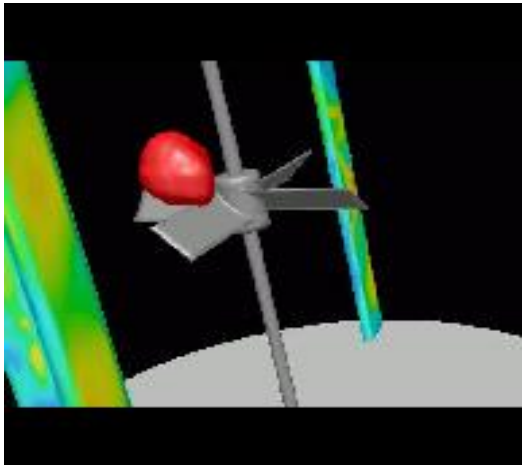
Volume fraction of gas bubbles in a fluidized bed with internals (solid volume fraction is in red)



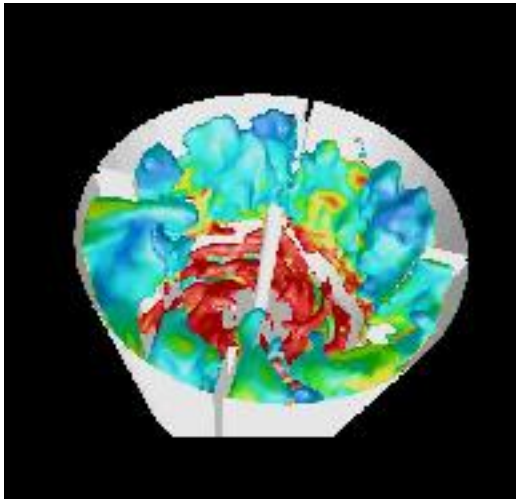
Segregation of particles of different sizes in a fluidized bed (blue particles are heavier)

Final capability examples

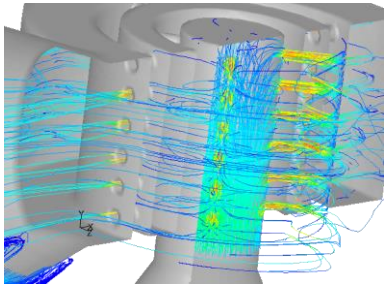
Mixing (the wow factor) , flow control equipment



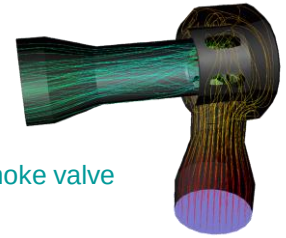
Composite animation of species mixing downstream of a PBT impeller and the pressure pulses on the baffle



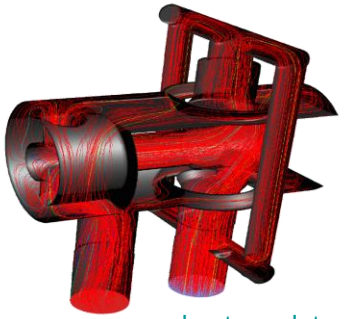
Macro mixing structures, colored by vorticity contours, in a mixing tank with a 6-balded Rushton impeller



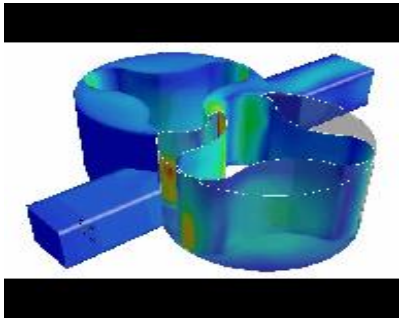
Flow streamline for a petroleum control valve



Choke valve



subset regulator



Fluid pressure fields in a lobe pump

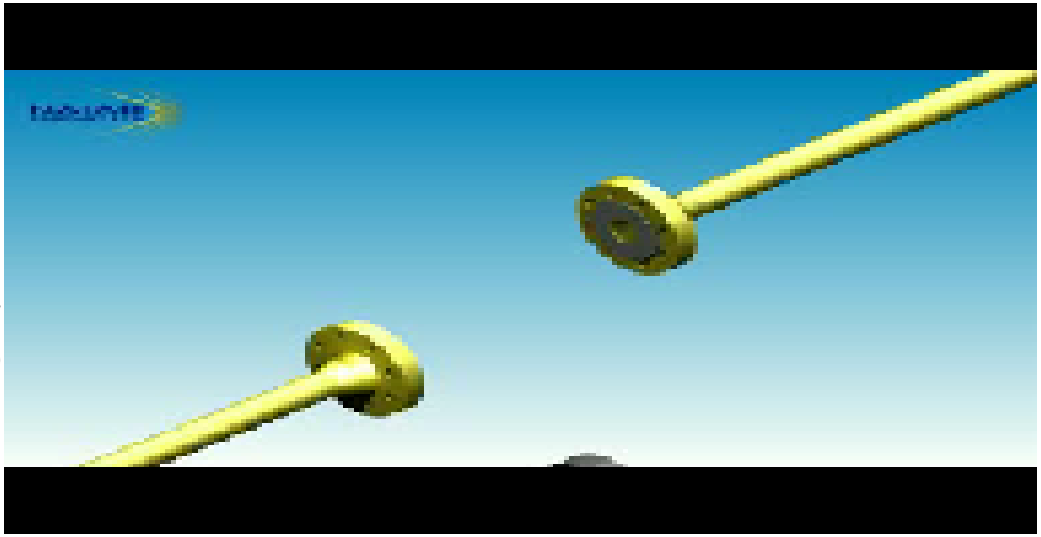
Pressure contours on a sliding valve

NAIAD Products - Mision™

NAIAD's first patented system, designed for high pressure flanged connections.

Features

- 15 minute installation
- Enables pre-spooling and cold bent piping
- Volume production of spools for standard packages
- Labour efficiency
- Elimination of manual fit-up
- Elimination of thermal pipe overstressing
- Blocks pipe vibrations
- Dampens flow pulsations



ASME certified

- 150 to 2500# ratings
- 2" to 24" nominal sizes
- Sweet, sour, acid services
- Regular and low temp
- -50F to 400F fluids
- +/- 5 degrees radial mis-alignment
- +/- 5" axial misalignment
- +/- 5" thermal expansion or contraction