Vibration, dynamics and noise

Improving the integrity, reliability and performance of piping systems, structures and rotating equipment.

wood.

Wood's comprehensive approach to fatigue management ensures vibration integrity and reliability issues are managed throughout the asset's life cycle.

This includes engineering design, field services, monitoring and solutions for production machinery, piping, structures and FPSOs. Our experience encompasses upstream, including subsea, downstream and LNG facilities.

Industry challenges

Most production facilities will face some type of vibration or noise issue. If not addressed, machinery, piping, or structural vibration will lead to long-term concerns with asset integrity, reliability, and safety with high-impact consequences. Besides the loss of production from downtime, there are even greater risks from effects on worker safety, the corporate liability.

Vibration, dynamics and noise is a highly specialised and complex field. This can cause challenges for facility operators because projects often use different suppliers, which results in a fragmented approach that creates confusion, integrity gaps, re-work, redundancy, and communication gaps. It also results in much higher costs.

Our solution

Our experts have the experience and capabilities to solve these challenges. We can address all vibration and dynamic needs across the entire life cycle of an asset, providing the most comprehensive service offering in the industry as part of our Asset Integrity Solutions service line. This includes:

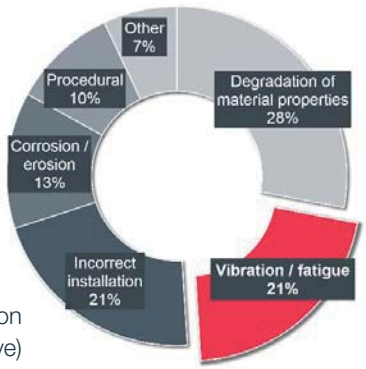
- Vibration and noise engineering during FEED, detailed design
- Design solutions for rotating equipment, piping and facilities
- Risk-based inspections and baseline acceptance testing
- Monitoring and troubleshooting services to support operations and optimise maintenance
- Vibration solutions for piping, vessels and machines

Benefits

- **Lower capital costs** – through fit-for-purpose design recommendations; less conservative engineering, less re-work, and elimination of redundant activities
- **Lower operating costs** – cost-effective monitoring and reliability programmes, machinery optimisation, reduced maintenance costs, efficient vibration inspection program
- **Improved integrity and safety** – significant reduction in machinery and piping failures (a major HS&E concern), compliance with noise guidelines, and other process safety requirements
- **Improved reliability and uptime** – reduction in breakage and performance-related problems, targeted monitoring programs
- **Improved asset management** – from FEED to operations to life extension

We are

- **Global leaders** in our disciplines, based on decades of experience
- **Superior** in our **capability offering**: full complement of in-house advanced analysis
- **Problem solvers**: combination of desktop simulation and field experts for optimum solution development
- **First-class** in our **service**: in-house software tools, resulting in i**mproved accuracy, faster service,** and **lower costs**
- **Thought leader** based on our strong commitment to **research, innovation** and **knowledge sharing** in the industry
- **Consistent** in our **delivery**: **standard processes** and **quality control** for site inspections, simulations, anomaly management, vibration and noise mitigation



21% of hydrocarbon releases are due to fatigue and high vibration
(Source: UK Health and Safety Executive)

Vibration, dynamics and noise services overview

Static equipment and structures	Machinery analysis	Rotating equipment reliability	Noise management	Field engineering, troubleshooting and implementation
Process and utility pipework, small-bore connections, subsea piping	Compressors, pumps and other rotating machinery	Condition monitoring, machinery reliability, strategy	Health, safety and environment; management and compliance	Site support for piping, machinery, structures and noise
Piping vibration: ▶ Risk assessments (EI) ▶ Flow and acoustics (FIV, FIP, AIV) ▶ API 521, flare system ▶ API 579, fitness for service (level 1-3) Transient analyses: ▶ Surge, water hammer ▶ Hydraulics ▶ Multiphase and slug ▶ Flashing Static analyses: ▶ Pipe stress ▶ Nozzle load Foundation: ▶ Skid and concrete ▶ Lifting and transport	▶ Vibration ▶ Pulsation ▶ Performance ▶ Torsional/lateral ▶ Bearing/coupling selection ▶ Compressor surge dynamics ▶ Numerical simulations (FEA, CFD) ▶ API 618, 674, 619, 688 vibration ▶ Vertical pumps, reed critical frequency (RCF) ▶ Skid dynamics	▶ Maintenance (RCM) and monitoring program strategy ▶ Condition monitoring ▶ Vibration, used-oil analysis, performance, thermography monitoring ▶ Technology qualification, failure modes (FMEA) ▶ Remaining useful life assessment ▶ Spare parts management	▶ Noise design studies ▶ Workplace noise & human vibration surveys ▶ Environmental noise impact assessments ▶ Workplace and environmental noise management ▶ Noise control and mitigation ▶ Noise propagation modelling ▶ Underwater noise	▶ Baseline surveys ▶ Vibration, pulsation, noise, torsional, transients, stress, modal testing ▶ Troubleshooting ▶ Electrical systems interaction ▶ Small-bore inspections ▶ Root cause analysis (RCA) ▶ Performance testing ▶ Balancing, shaft alignment ▶ Acceptance tests (FAT, SAT) ▶ Implementation support

Anti-vibration products

- ▶ DamperX™ clamps and braces
- ▶ Vibration clamps
- ▶ Vibration absorbers
- ▶ Customized solutions

Support through the asset's life cycle

FEED
- ▶ Design documentation and recommendations
- ▶ Qualitative risk reviews
- ▶ Technology qualification programs
- ▶ Specifications
- ▶ Value engineering, equipment assessments, layout reviews

Detailed design
- ▶ Quantitative risk assessments (EI guidelines)
- ▶ Design engineering studies (see above services)
- ▶ Code compliance checks and reviews
- ▶ Detailed FEA; stress and fatigue life predictions

Commissioning
- ▶ Acceptance tests (FAT, SAT)
- ▶ Baseline measurements
- ▶ Vibration, stress and noise inspections

Operations
- ▶ Troubleshooting, problem solving
- ▶ Monitoring programs
- ▶ Reliability & maintenance support
- ▶ Periodic and proactive inspections
- ▶ Performance testing

Brownfield
- ▶ Debottlenecking, fatigue risk management
- ▶ Management of change (MOC) when adding new equipment or changing operations

Life extension
- ▶ Remnant life assessments (RLA)
- ▶ Vibration and stress analyses
- ▶ Inspection audits
- ▶ Fitness-for-service assessments

- ▶ Training courses available for all service areas

Wood is a global leader in the delivery of project, engineering and technical services to energy and industrial markets. We operate in more than 60 countries, employing around 55,000 people, with revenues of over $11 billion. We provide performance-driven solutions throughout the asset life-cycle, from concept to decommissioning across a broad range of industrial markets including the upstream, midstream and downstream oil & gas, chemicals, environment and infrastructure, power & process, clean energy, mining and general industrial sectors. We strive to be the best technical services company to work with, work for and invest in.

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