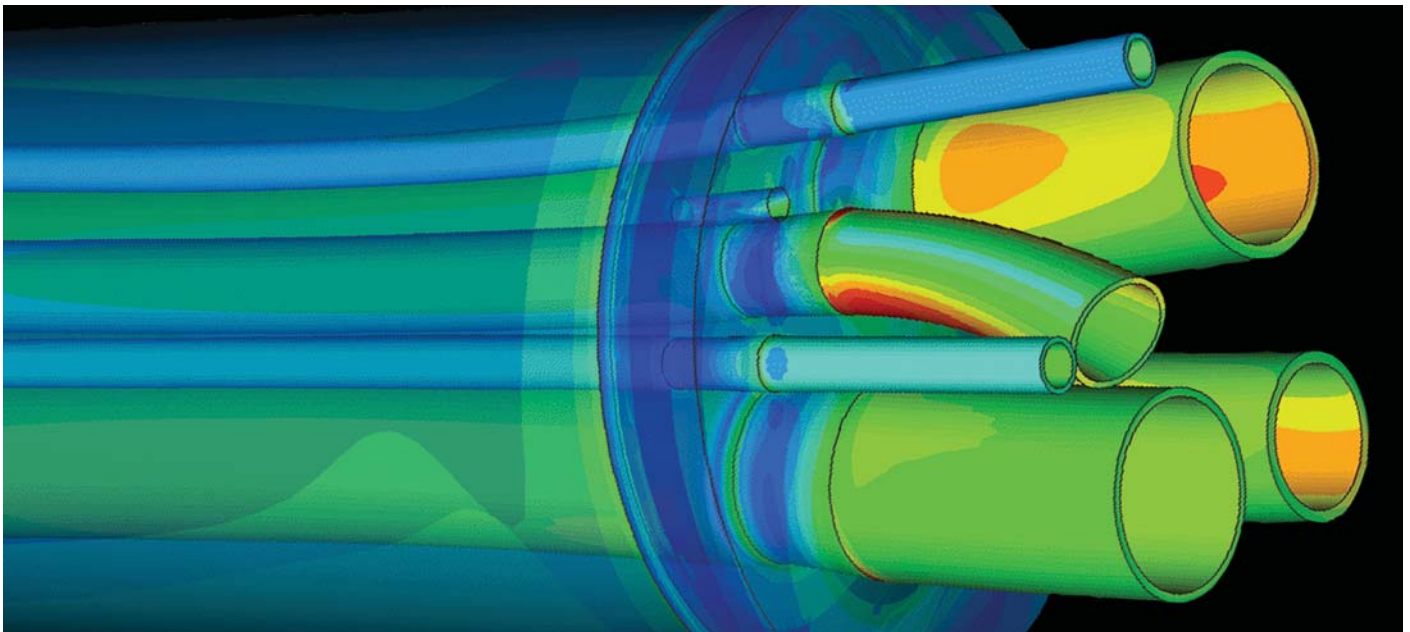




# Advanced Structural Analysis

The Structural Engineering team's expertise rounds out the oil and gas consultancy services offered by Xodus, enhancing core competencies in subsea engineering, technology development and application, environmental compliance, technical safety and risk consultancy, and process management and flow assurance.



Responsible for invaluable contributions to conceptual studies on platform modifications for a number of our clients, Xodus has extensive experience of major greenfield and brownfield developments, and in assessing existing structures. We are also specialists in the use and application of advanced structural analysis techniques, including NLFEA (Non-Linear Finite Element Analysis) and experts in using tools such as SESAM, ABAQUS and USFOS to solve problems in

brownfield and greenfield developments, forecast the consequences of accidental damage, and assess new technologies implemented in offshore environments.

### **Advanced design and analysis**

We apply a simple principle: all structures – primary and secondary – should be designed to minimise the overall cost to the client once all relevant factors have been taken into consideration. Our teams design new

structures and analyse and redesign existing ones to establish maximum load capacities, extend and optimise design life, and incorporate modifications. We also draw up installation/removal studies and provide engineering support. We can review third-party designs and studies, and either focus our efforts on specific aspects (such as hazard mitigation or performance standards analysis), or else manage your entire project from preliminary study through to final completion.

### How structural engineering helps clients

In the current economic climate, there are plenty of opportunities to develop small fields, provided they can be exploited economically – ideally by using an existing platform. But many offshore structures have exceeded their original design lives, and some are thought to have reached their topside load limits. By applying cutting-edge structural analysis techniques, Xodus devises development concepts that maximise value – for example by showing that many of these structures can continue to perform safely during their extended design life, even during sustained periods of maximum topside loading.

### Taking an integrated approach

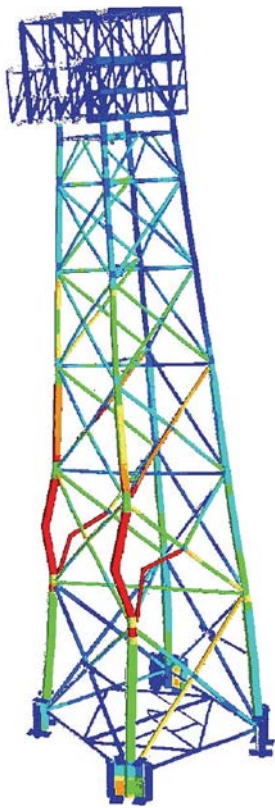
Traditional elastic techniques define failure as the moment at which individual structural elements exceed permissible tolerances. The Ultimate Strength approach used by Xodus – also known as the Plastic Limit State technique – focuses on the integrity of the entire structure, making allowances for local yielding and load redistribution.

As long as overall integrity is maintained, designers can use the Plastic Limit State approach to take advantage of any reserve strength inherent in the structure.

### What does this mean?

The best way to calculate a platform's reserve strength – i.e. its true load-bearing capacity – is to apply the non-linear pushover technique. The pushover complies with recognised codes such as API-RP2A-LRFD whilst avoiding the oversimplification of traditional codified approaches. By applying this technique as early as possible in a project, clients can avoid much unnecessary work – and cost.

NLFEA can also be applied in the later stages of a project to minimise, optimise or even totally eliminate strengthening.



Typical Pushover Analysis.



Typical FE Analysis.

### What are the other benefits?

Structural analysis also offers other advantages, helping to resolve controversial issues such as fire and blast protection (often eliminating the need for additional protection), ship impact, extreme wave analysis (e.g. the “10,000-year wave”), materials fatigue, dropped-object impacts, and erosion or corrosion in vessels, piping, manifolds and other structures. Typically, repair and maintenance schedules can be optimised or even eliminated completely, but advanced analysis also shows when repairs can be deferred to minimise platform downtime.