



# Great Yarmouth Sea Life Centre

## Company Profile: Lordham Johns

Operating throughout the UK from offices in Great Yarmouth, Norwich and Chelmsford. Lordham Johns offers consulting structural, civil, highway and drainage engineering services. However a tender for a new Shark tank for Great Yarmouth Sea Life Centre afforded Lordham Johns an interesting professional diversion.



## The Design Concept

The combination of complex structural geometry, abnormal loading conditions and unusual materials is a tough technical proposition. With a good view in mind, Fordham Johns proposed a challengingly different shark tank. Holding 260,000 litres, the tank is an irregular octagon of 11.5 by 9.2 by 3.5 metres (deep). Openings include an acrylic hemispherical viewing bubble, an 8 by 3.3 metre outward sloping glazed face and an 11.2 by 2 metre diameter sub-surface walkway. Over 270 tonnes of seawater had to be safely contained.

According to John Clare, Technical Director, the shark tank project was part of the Great Yarmouth Sea Life Centre development. Marine exhibit tanks have unusual structural features including constant full loading. Add viewing bubbles, underwater walkways with glazed sides and the design problems become acute.



## The Solution

To analyse the design Fordham Johns turned to Graitec UK's SuperSTRESS for frame analysis. Normally deployed on structural problems such as space frames and offshore structures, SuperSTRESS proved invaluable. Mounted on legs, the tank's design called for 10mm smooth steel sides supported by an "exoskeleton" of steel members. A top-mounted ring beam prevents outward movement of the vertical grillage.

Although the steelwork was straightforward, the apertures were not. Comparative vulnerabilities in the glass, acrylic and silicone sealants posed a real threat. To discover safe working limits. SuperSTRESS analysed some "uneven and very strange" deflection patterns.

Having input over 500 node points for a full three-dimensional analysis, the design was modelled down to individual member level. The main criteria, recalls Clare, was stiffness rather than bending to prevent distress on the glass, acrylic and sealants.

"We modelled the supporting ribs, the 10mm steel plate and the ring beam to determine the deflections on the openings."

Understanding the complex interactions between materials became essential. For example, the front elevation includes 60mm thick three-quarter tonne laminated glass panes, 200 litres of silicon sealant and glass mullions. An 11.2 metre walkway, extending through the tank, uses 60mm thick acrylic.

Repeated 3D modelling runs with SuperSTRESS provided bending moments, stresses and deflections. Cautious adjustments were made to member configurations until the deflections were within acceptably safe limits.

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### **Subsequent Developments**

Having proved the final design, the tank was constructed, filled without incident and is now a popular attraction for visitors. Fordham Johns has since worked on other aquaria, including one in Holland.

SuperSTRESS's versatility, over the last six years, receives high praise from Technical Director John Clare, "SuperSTRESS is a very comprehensive, user friendly and intuitive solution. It's our main method of analysing structures. You can also use it immediately without spending hours reading the manual."

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