

DOMM DEVELOPMENTS SLIMLINE POLYETHYLENE TANKS

Non-Linear Geometric Analysis

Date: October 2010

Client: Hercules Constan Lawyers on behalf of Domm Developments

Project Description:

David Beneke Consulting was commissioned by Hercules Constan Lawyers acting for Domm Developments to investigate the structural performance of two elliptical shaped slimline above ground water storage tanks using finite element analysis (FEA). The first tank was 2,000 litre capacity whilst the other was 1,600 litre capacity. Both tanks were manufactured from linear low density polyethylene (LLDPE) using the rotational moulding process.

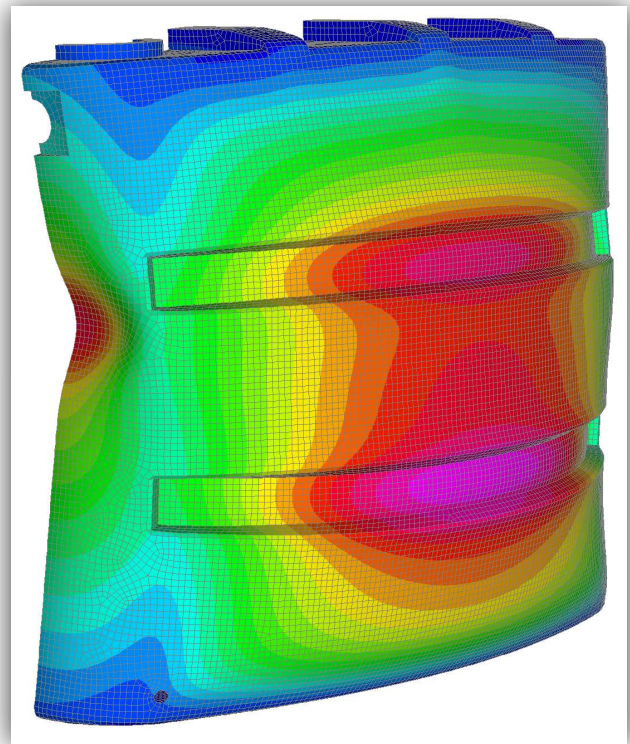
The geometry for each tank was imported into Strand7 FEA software and meshed using QUAD4 plate/shell elements. Penetrations at the inlet, outlet and overflow holes were included. Only a half FEA model was created given that the tanks were symmetric about their longitudinal axis. The material properties for the LLDPE material were essentially linear elastic. However, the values adopted were based on long term creep occurring in the material over a 20 year period.

Initial analyses indicated that both tanks were prone to premature creep induced buckling. The buckling mode shaped typically involved an outward bulging of the side wall accompanied by vertical buckling of the end walls. This buckling mode was similar to that encountered in service.

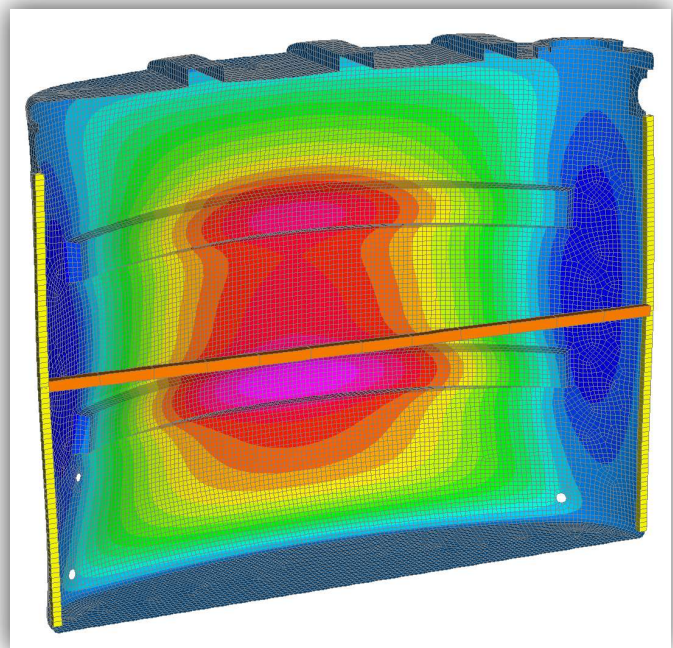
Additional analyses were then undertaken on the same tanks with a stainless steel frame retrofitted within. The analysis results indicated that whilst this frame arrested the premature buckling, it did not assist in arresting the large bowing deflections in the side wall of the tanks nor the high stresses induced in the tank wall.

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Buckled shape of the 2,000 litre slimline tank.



Side wall deflections of the 2,000 litre slimline tank with stainless steel frame inserted.