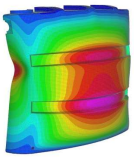


David Beneke Consulting

Finite Element Analysis for Engineering

SUBARU TIME ATTACK RACE CAR - CARBON FIBRE UNDERTRAY
Linear Static and Linear Buckling Analysis

Date: January 2015

Client: David Stelzer

Project Description:

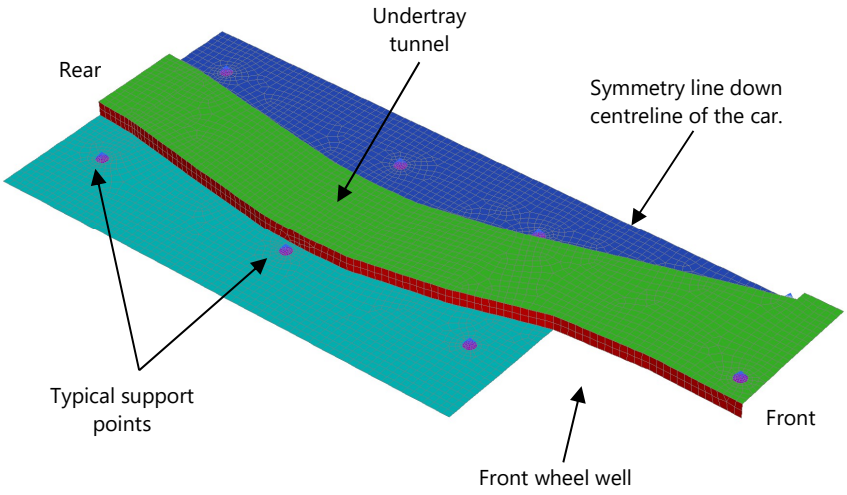
David Beneke Consulting assisted David Stelzer to analyse and optimise a carbon fibre undertray for his 2005 Subaru STi time attack race car. The undertray which is attached to the underside of the car plays an important role in that it assists in providing down force and therefore enhanced grip. Finite element analysis was used in particular as a means of being able to minimise the mass of the undertray, reduce production cost and assist in maximising the performance of the vehicle.

The geometry of the undertray FEA half model (which extended from the forward end of the front wheels to the forward end of the rear wheels) was measured directly from the mould or "plug" as it is commonly referred to. The undertray structure was simulated using 2D plate/shell elements typically with pinned links at support points in a "spider" arrangement. Applied loads consisted of self weight and 2 different wind pressure distributions - uniform and patterned.

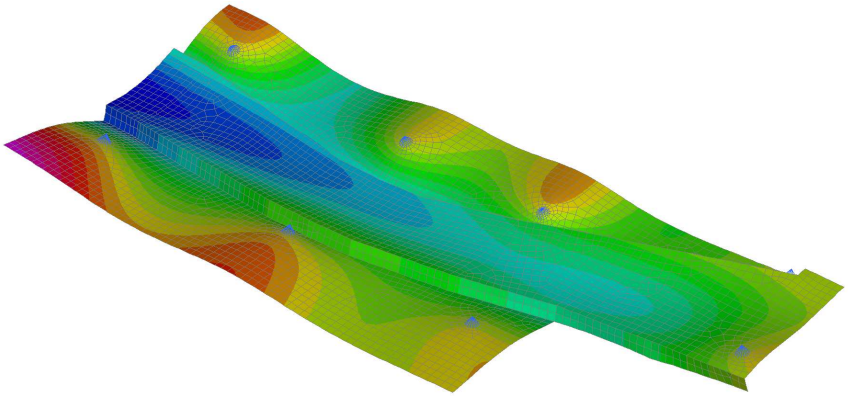
The material properties associated with plain carbon fibre composite was sourced from published data. However in certain areas a foam core composite was used. In these areas the results of 3 point bend tests was used to derive material properties and material limits.

Linear static analyses were undertaken to evaluate the maximum strains on the undertray as well as the induced deflections at ultimate and serviceability limit state respectively. Linear buckling analyses were also undertaken at ultimate load combinations to assess buckling characteristics.

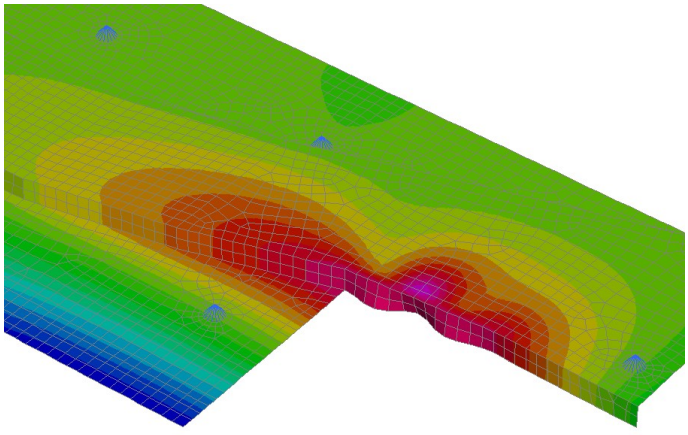
Overall the analysis was able to limit the amount of foam core composite construction required in the manufacture of the undertray which had a significant saving in weight and manufacture time.



FEA model of the carbon fibre undertray.



Vertical deflection results for combined pattern wind load and dead loading



Linear buckling analysis results showing distortion buckling of the forward tunnel face.

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