LCFI Interim results

The Mechanical Design Aspects

by

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25 / 10 / 2001

Aim of this exercise

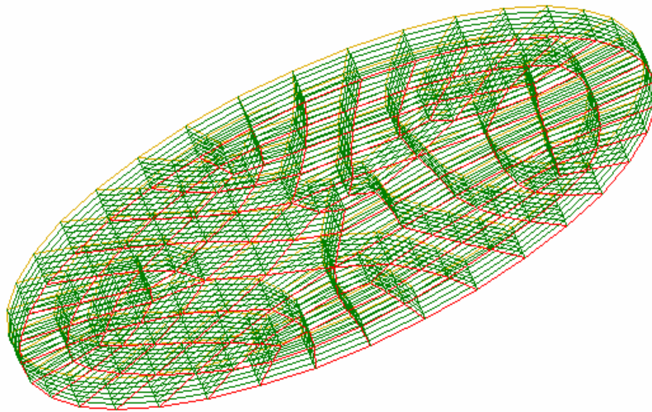
The aim of this exercise is to establish how stress varies with the changing glue sizes during thermal contraction

It was noticed in the previous analyses that the glue is likely to develop a stress exceeding its yield level during curing. We need to understand if this high stress will gradually "die down" when the material relaxes through fragmenting at the outer surface. If so, what that stress would be.

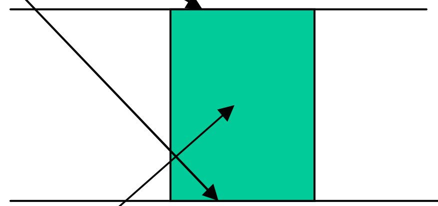
It also tries to establish how the stresses are affected by the flexibility of the CCD to which the glue is attached. Two models were set up

- Fully fixed at the top and bottom surfaces of the glue blob;
- Top and bottom surfaces connected to the CCD ladder and block which are separated by a pair of spacers and which are fixed at some distance away from the glue.

FE model of a glue blob

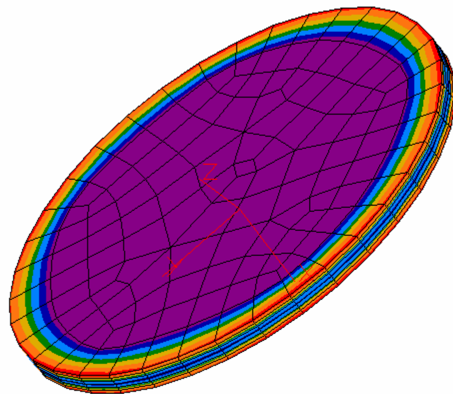


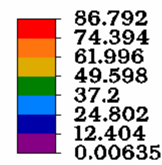
Fully fixed at the top and bottom surfaces



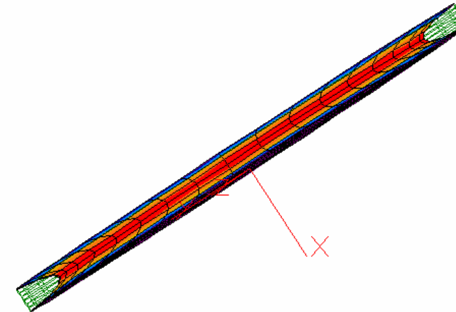
Glue with -100 C dT

Stress and Displacement profile of a 1mm dia by 0.05mm thick glue (no flexibility contribution from the CCD)



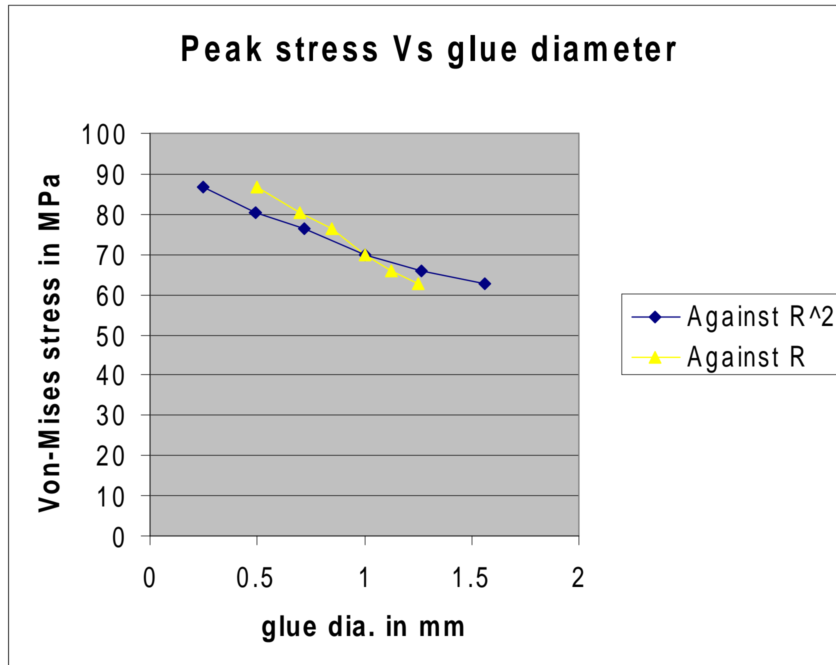


Stress profile

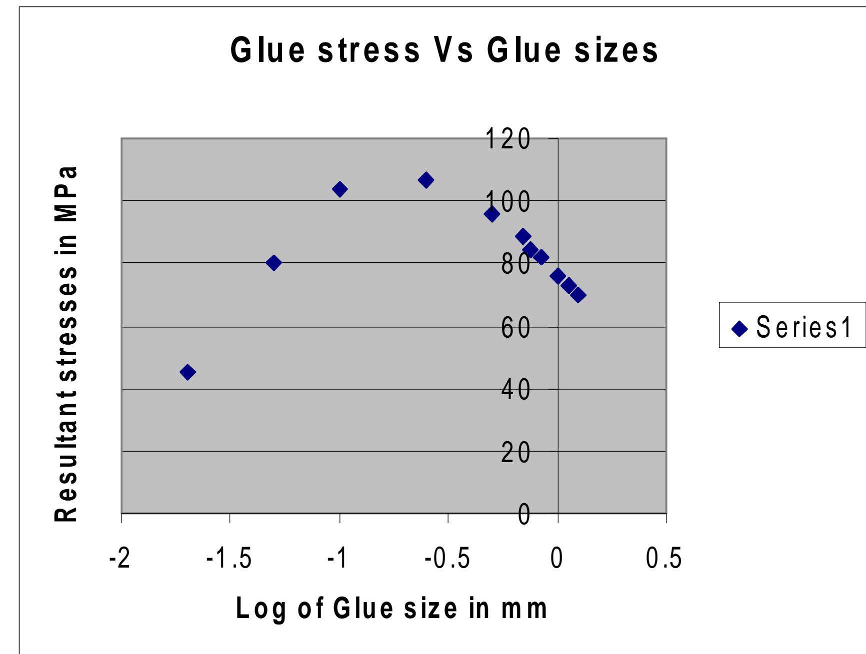


Displacement profile – looking across the glue thickness

Peak stress developed on different glue sizes under thermal contraction



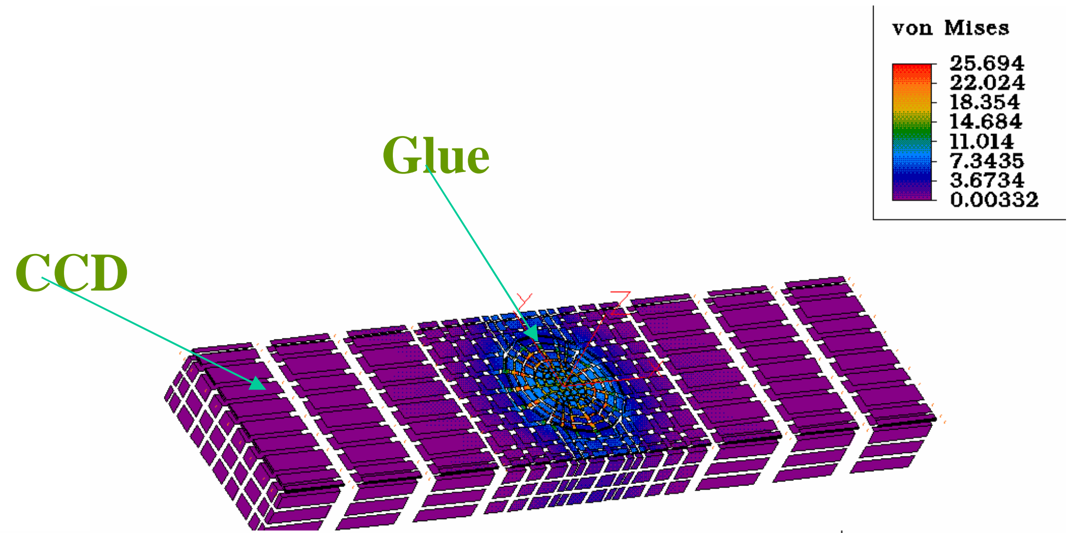
Glue above 0.25mm dia



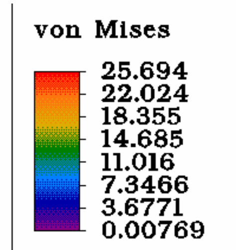
Glue between 0.02mm to 1.5mm

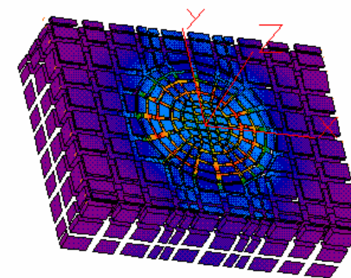
This model looks at the stress reduction at the glue due to a flexibility contribution from the CCD

Flexibility contribution from the CCD reduces the peak glue stress from 87MPa to 25 MPa



Glue attached to part of the CCD





Local model showing Glue stresses (with attachment to CCD)

Observations:

The CCD provides significant flexible connection at the glue ends which helps reduce the glue thermal stress.

The study revealed an interesting stress pattern. In that, for a certain glue diameter range, the peak thermal stresses increase with reducing glue sizes. This pattern is reversed when the glue sizes falls above and below this range.

We are currently studying the mechanism for this behaviour, and work out exactly what this thresholds are. If this pattern persists, it would be possible for the glue to be overstressed to begin with and lose some of its load bearing area. It should then shakes down to a stable size where stress are progressively reduced as the glue sizes reduces.

The credibility of the above comment depends on a valid explanation being found for the glue size Vs stress behaviour.