Background, Motivation & Aim

- Polymeric foam cored sandwich structures are being used widely in aerospace, naval, transportation and civil engineering industries.
- The mechanical properties of polymeric foam core materials may experience significant degradation in their properties at elevated temperatures due to the viscoelastic nature.
- The degradation of foam core material can exert a significant influence on the linearity and stability of the sandwich structure behaviour.

Objective:

- Develop a qualified methodology to identify the degradation of polymeric foam core materials with temperature.
- Construct an experimental apparatus to investigate the sandwich structure mechanical behaviour subjected to a uniform and gradient thermal condition.

Testing Apparatus

Initial tests have been conducted to study the foam tensile and compressive properties at elevated temperature as shown in Fig. 3. The foam specimen is PVC Divinycell H100. Digital Image Correlation (DIC) is used here to measure strain on the surface of the specimen.

Unknown factors:

- Strain distribution
- DIC precision
- Alignment condition
- Window influence on DIC

DIC (Digital Image Correlation)

- Strain computed by DIC depends significantly on the subset size.
- 64 x 64 pixel subset brings noisier strain.
- 256 x 256 pixel subset over smooths the non-uniform strain.
- 128 x 128 pixel subset introduces an optimised strain distribution.

Alignment identification

The alignment condition was identified by measurement of the strain on the two opposite surfaces simultaneously, and any bending alongside the tensile & compressive load can be quantified.

Window influence on DIC

The optical window was verified to have little influence on the 2D DIC measurement!

Strain distribution

Non-uniform strain is found, and the uniformity depends on the specimen dimension and properties.

$$E_{\text{surface}} \neq E_{\text{bulk}}$$

Surface strains need to be corrected to the bulk average strain to derive accurate moduli and Poisson’s ratio.

Test results

- A linear degradation was found from 33°C to 65°C, and non-linear from 65°C to 90°C.
- The moduli decrease significantly after about 65°C.

Conclusion

A reliable methodology is proposed to obtain the thermal degradation of the linear elastic properties of foam core materials using non-contact optical extensometry.