TAPESTRY CONSERVATION

Principles and Practice

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Mechanical testing and its role in the condition assessment of tapestries

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The deterioration of tapestries can be attributed to the combined effects of external environmental conditions, such as fluctuations in relative humidity and exposure to light, and inherent factors, such as the nature of their component materials and the effect of supporting their own weight over long periods of time. As the environmental conditions fluctuate and the tapestry deteriorates, the effects of their own weight on its integrity will also change. Ultimately failure, to use an engineering term, will occur when the weight of the tapestry exceeds its strength.

In conservation, it is commonplace to evaluate the condition of an object by assessing the integrity of its structure and its chemical stability. In engineering, mechanical testing is an essential part of assessment as it provides important information about the materials and structure under investigation. The authors, an interdisciplinary team from the University of Southampton, are investigating the application of non-destructive strain monitoring techniques to historic tapestries. The purpose of this chapter is to describe the testing approaches used in engineering and to relate these to tapestries. In order to facilitate cross-disciplinary exchange, the technical language of engineering is explained to make it accessible to conservation specialists.

The major objective of a mechanical test is to determine the mechanical properties of a material (in this case a textile). One of the mechanical tests most commonly used in engineering is performed under *tension* and is therefore known as a *tensile test.* The tensile test is generally performed on flat specimens using a specialist test machine. This test is well known to engineers, textile technologists and textile conservators; however, its application to historic textiles is relatively uncommon. This chapter provides a description of a typical machine, test pieces and material properties derived from such a test. It is shown how the derived material properties are used in the condition assessment of tapestries and their usefulness in this context is explained. A further mechanical test, known as the 'creep test', is also described. This test models the material behaviour under a constant load over an extended time period, such as that experienced by a tapestry on display as it deforms due to its own weight.

Engineers use mechanical tests to characterise materials. In tapestries it is particularly important to identify the properties in both the warp and weft directions as they may be different. Therefore, a further objective of this chapter is to explain *isotropic* and *anisotropic* material behaviour in terms of a tapestry. The derived properties must be attributed to the structure correctly so that the behaviour of the tapestry under its own weight can be established. Various condition monitoring techniques are introduced below and their suitability for application to tapestries is discussed. The potential for the application of these techniques to the conservation of historic artefacts has been recently reviewed (Dokos et al., in preparation).

Isotropic and anisotropic materials

The purpose of so-called structural materials is to support *mass*, or more correctly *weight* (i.e. the product of mass and gravitational acceleration). This weight is