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M. Kaliske and J. Eberhardsteiner (Eds.)

EUROMECH Colloquium 556
Theoretical, Numerical, and Experimental Analyses in Wood Mechanics

Dresden, Germany, 08-10 May 2015

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Chairmen

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Keynote Lectures

Contributions

Residual viscous and MS deformation of an antique violin as a parameter to understand the mechanical effects of a concert.

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1 Introduction

Historic wooden musical instruments are often valuable objects prized by players for the high quality of their sound. However, in some cases historical violins are considered to be cultural heritage objects. One such case is the "Cannone" violin, which was made in 1743 by Giuseppe Bartolomeo Guarneri "del Gesù". Since 1851 the violin is property of the Genoa Municipality and considered mainly a masterpiece in instrument making and of great historical importance rather than a musical instrument for concert activity. A large project to assess the state of conservation of the violin was promoted by the municipality and the following points analysed: (1) a structural assessment and the computation of the deformative field under load (Fioravanti et al. 2012); (2) the hygro-thermal conditions of conservation were assessed (Goli et al. 2012); (3) the mechanical time-dependent behaviour in constant and variable relative humidity studied (Fioravanti et al. 2013). The time dependent behaviour, and in particular possible permanent residual deformation, of the violin after loading at constant and varying relative humidity were assessed in order to understand the effect of stresses on the violin during a concert.

2 Material and method

The instrument was loaded in three ways:

- -by tuning the instrument to playing pitch and leaving the instrument loaded for 25 hours and 46 minutes at constant RH conditions [TEST 1];
- -by applying at the bridge level and with the same contact points the force of 21.09 N by a dead mass and leaving the instrument loaded for 5 hours and 36 minutes at constant RH conditions [TEST 2];
- -by applying at the bridge level and with the same contact points the force of 21.09 N by a dead mass and leaving the instrument loaded for 3 hours and 6 minutes with an RH step of -10% for 1 hour and 30 minutes [TEST 3].

The deformation was measured in the central line as the difference between two lateral transducers touching the ribs and a central one. The force applied by the dead mass was computed in order to be able to produce 55% of the deformation after normal tuning for safety reasons.

3 Results

The averages environmental parameters during the tests as well as the deformations measured are reported in Table 1 where the unrecovered deformations are reported as well.

Tab. 1 Average environmental parameters during the tests and measured deformations.

TEST 1		
Average RH	51.5 (SD 0.3)	%
Average T	21.4 (SD 0.8)	°C
Elastic deformation	145.9	µm
Creep	22.2	µm
Unrecovered deformation	0.3	µm
TEST 2		
Average RH	47.2 (SD 0.5)	%
Average T	25.99 (SD 0.04)	°C
Elastic deformation	85.9	µm
Creep	14.7	µm
Unrecovered deformation	0.7	µm
TEST 3		
Average RH before the step	47.2 (SD 0.8)	%
Average RH during the step	39.7 (SD 0.3)	%
Average RH after the step	46.9 (SD 0.5)	%
Average T	25.99 (SD 0.04)	°C
Elastic deformation	85.9	µm
Creep	14	µm
Unrecovered deformation	0.1	µm

4 Conclusions

The tests were performed for loading periods much longer than a concert for TEST 1 and in line with the time of a concert for TEST 2 ad TEST 3. In each case the residual deformations were comparable to the measurement repeatability (0.25 µm), and so little to be considered to be completely recoverable, especially considering the accuracy of RH% regulation inside the experimental box that could lead to small hygroscopic deformations.

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