Enhancing track safety; the effect temperature has on the consistency of all-weather track surfaces in the UK

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All-weather racetracks

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Engineered to optimise biomechanical responses independent of environmental conditions

Temperature fluctuations are likely to alter the behaviour of the surface materials

Of particular interest:

i. The temperature that thermal transformation of the wax occurs
ii. The subsequent effect of this on surface function

Aim

To investigate behaviour of the all-weather track surfaces in the UK under three controlled temperatures using a randomised block design

H_1: Distinctly different temperatures will alter the functional properties of all-weather track surfaces in the UK

Latex-lined test boxes

Test boxes: 1m ^{2}
Base of box: compacted gravel
Bulk density: ~1.9g cm^{3-}
Weight of surface24.5 kg

Experimental set-up described by Mahaffey et al. (2013)

Figure 2. Test box design

Testing device to measure functional properties of a surface

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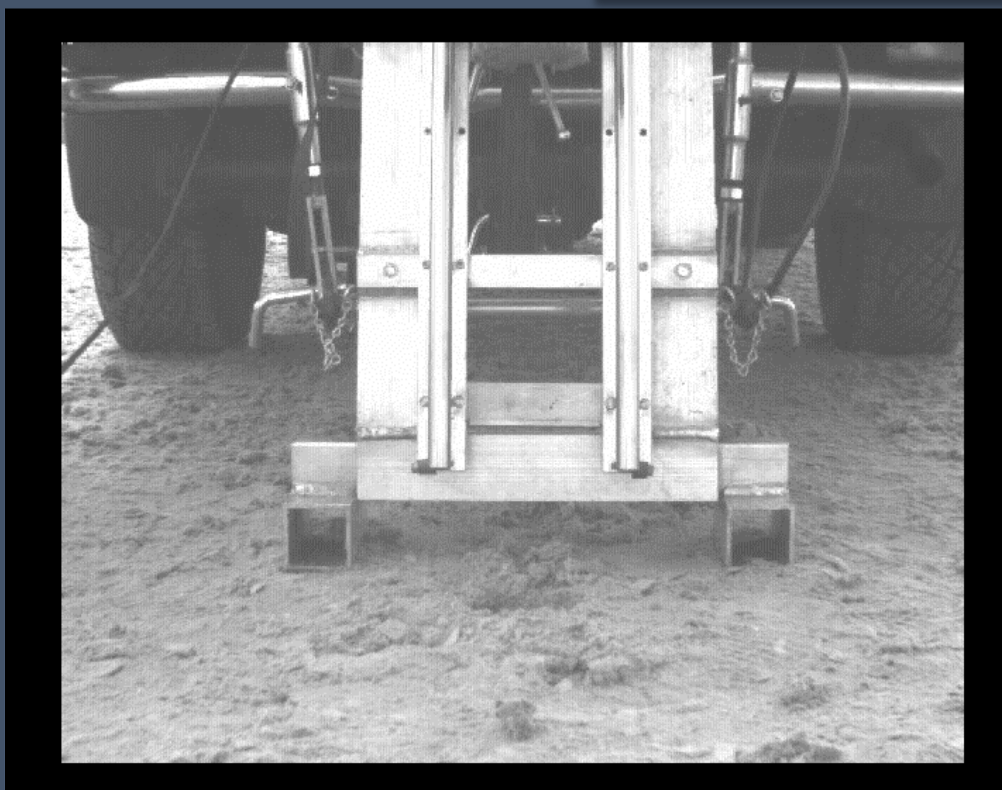
i. Linear potentiometer

ii. Tri-axial accelerometer

iii. Tri-axial load cell

iv. Aluminium hoof



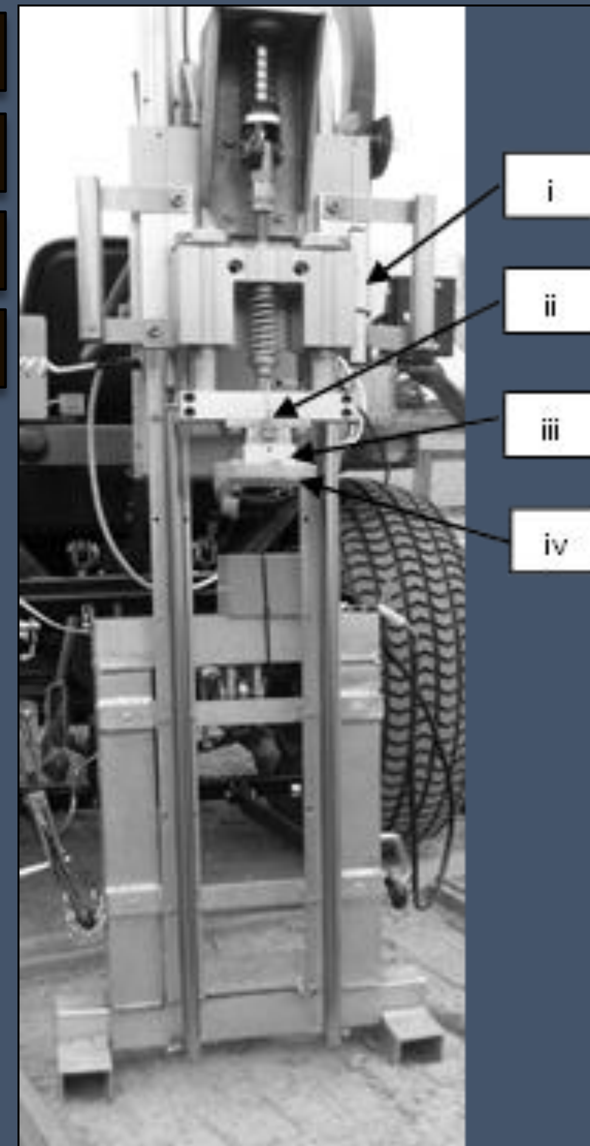


Figure 3. Orono Biomechanical Surface Tester (Peterson et al., 2008)

Testing device to measure rotational torque (Lewis et al., 2015)

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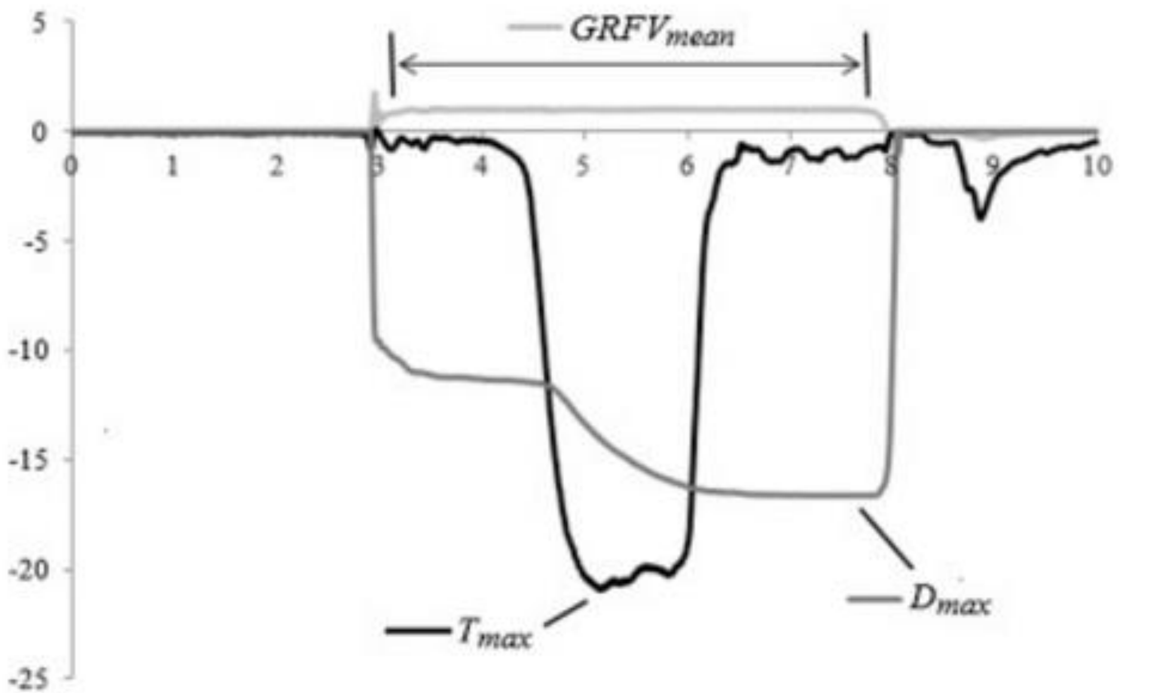

Fig. 4.

A typical graph from the GWTT. The graph illustrates signals for GRF_{mean} (the average of vertical GRF values over the time illustrated (kN)), $D_{max} \times 10$ (mm), T_{max} (Nm).

Track surface test box of all-weather track surfaces

Figure 5. Surface material from three UK racetracks

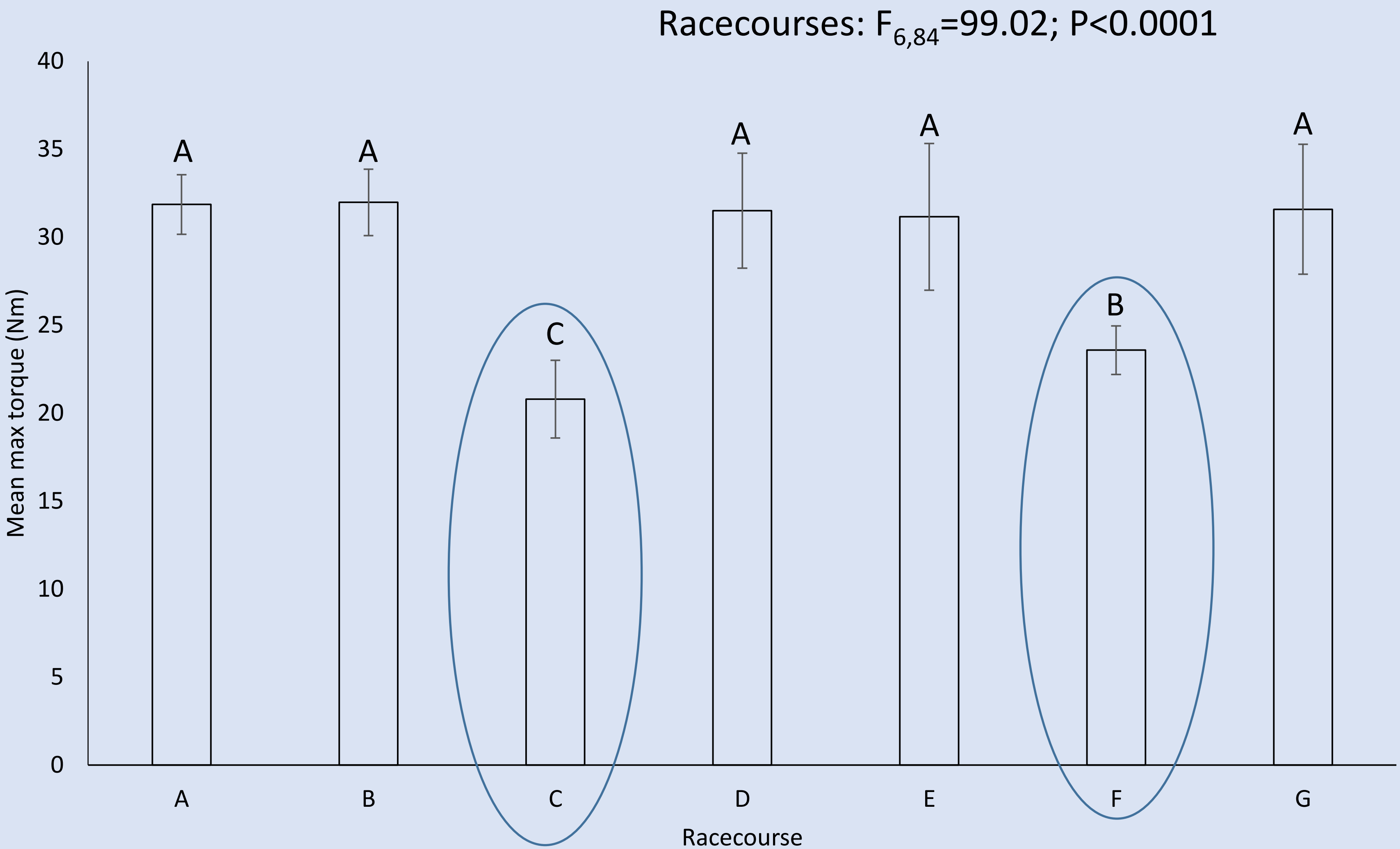

Figure 6. Mean maximum torque ±SD (Nm)

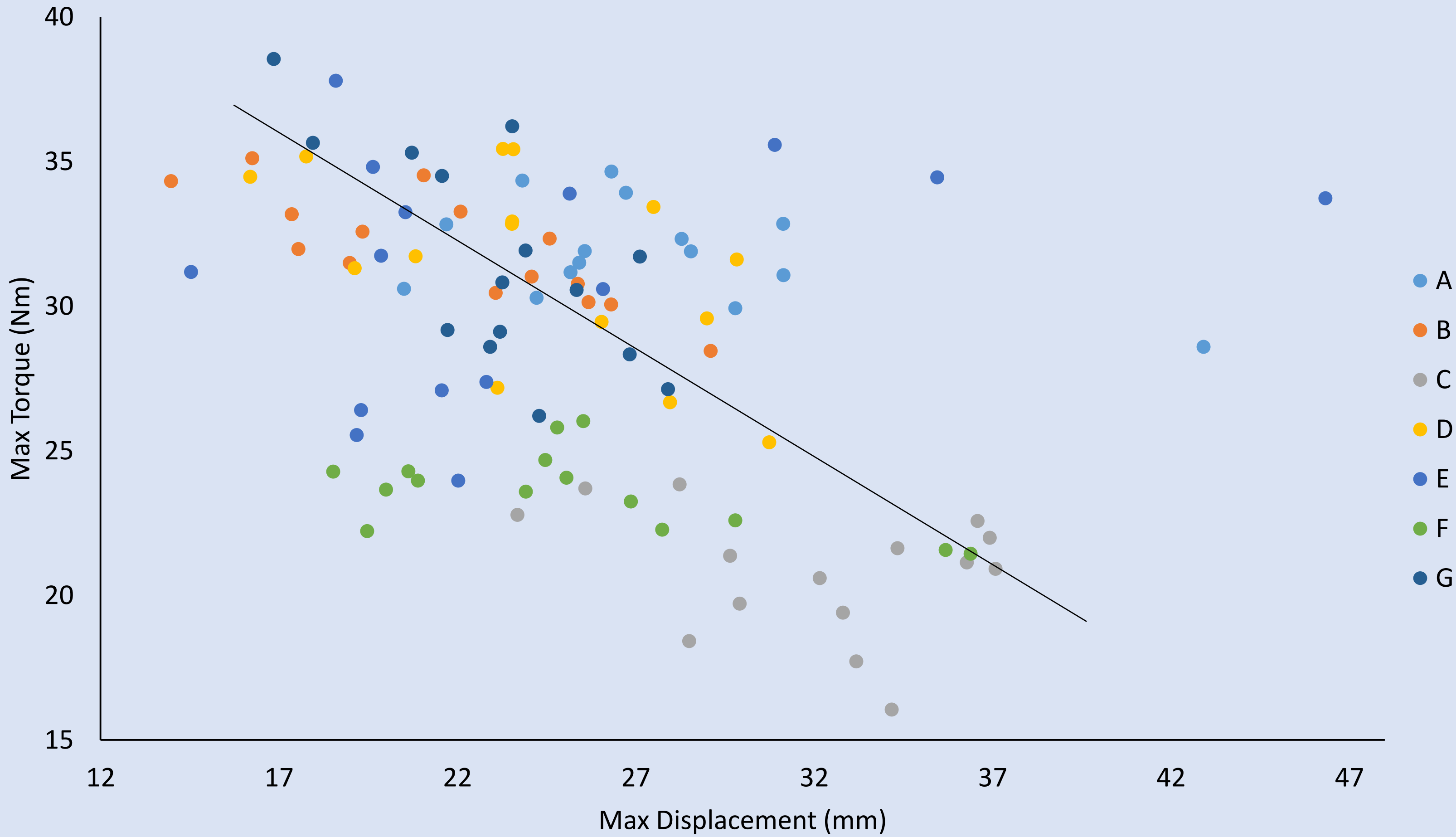

Figure 7. Negative correlation between mean maximum torque (Nm) and maximum displacement (mm) for racecourse. There was an overall significant correlation ($r = -0.436$; $P<0.0001$). Individually, surfaces C and E showed no significant correlation

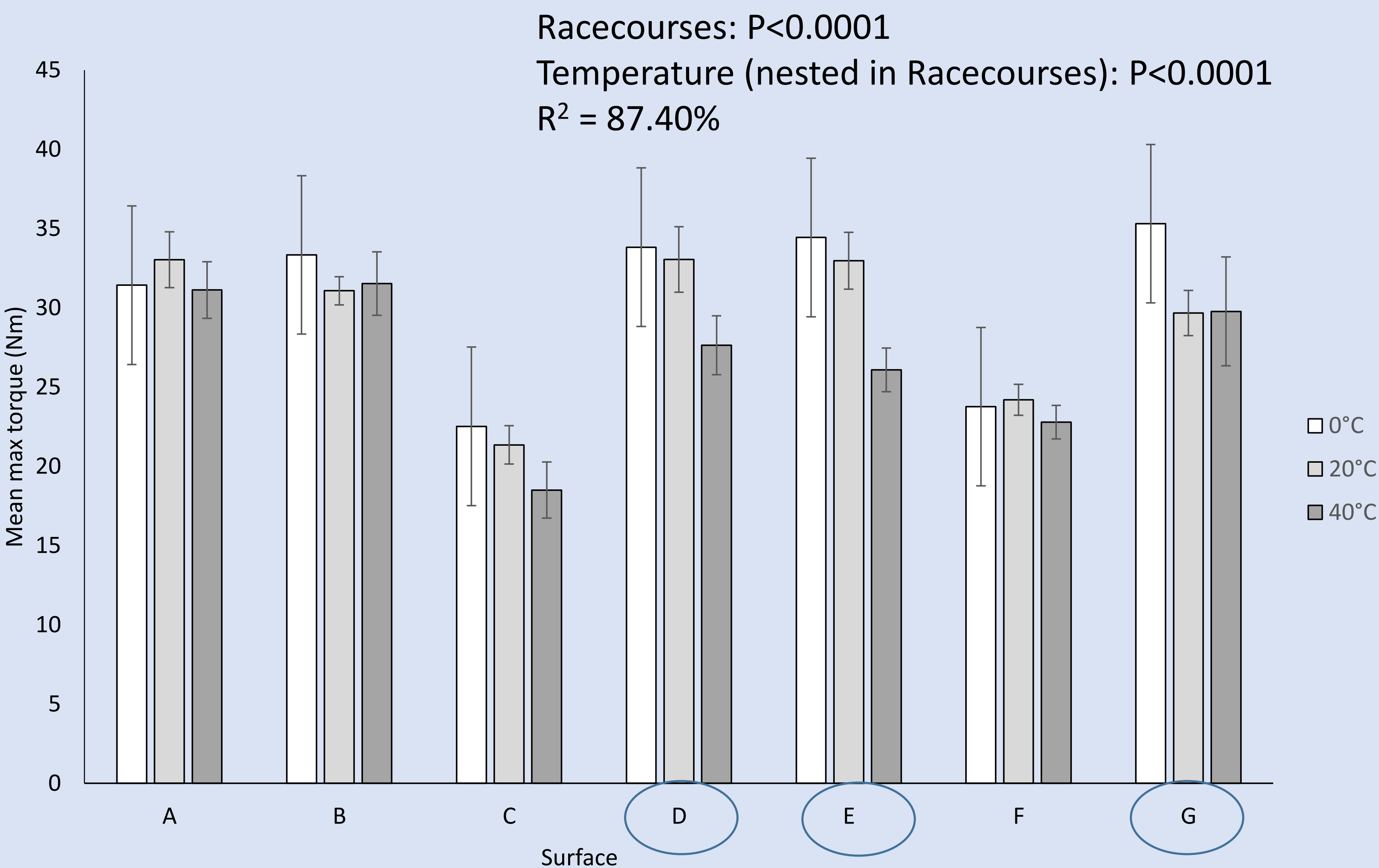

Figure 8. Mean maximum torque ±SD (Nm) for racecourse at three temperatures

Discussion points

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There is high variation in rotational torque in all the surfaces when the temperature was 0 °C (this may be important in UK tracks)

There are some significant differences in rotational torque at three distinct temperatures in some of the wax surfaces (higher rotational torque at 0 °C)

Thermal conductivity and heat capacity of surface materials and status of wax (i.e. quantity, type, longevity) should be considered in future track design

Acknowledgements and thanks to the team

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