Calculation of damping ratio for springboards

A drop test was performed (Nigg and Yeadon, 1987) in which a shot was dropped onto the two different surfaces (compliant springboard, firm springboard) from a height of approximately 0.5 m. The shot had the following properties: steel, mass = 26.7 kg, radius = 83 mm. The test was recorded using a high speed camera (Phoron Pro, AOS, Switzerland) at 200 Hz and was repeated five times on two replicates of each surface type. The damping ratio was determined using Eqn S1 and Eqn S2 (Nagurka and Huang, 2006).

\[ e^{-\frac{\pi \xi t}{x(0)}} = \frac{v_t}{v_0}, \quad (S1) \]

where \( e \) = coefficient of restitution, \( v_t \) = post impact velocity (m s\(^{-1}\)), and \( v_0 \) = pre impact velocity (m s\(^{-1}\)).

\[ \zeta = \frac{\ln \alpha}{\sqrt{\alpha^2 + (2\alpha)^2}}, \quad (S2) \]

where \( \zeta \) = damping ratio.

Calculation of stiffness of springboards

The height of the top surface of the springboard was measured with the board unloaded. The board was then loaded with a known mass (92.4 kg) and the height of the top surface under load was then measured. The board stiffness was then calculated using Eqn S3 (Nigg and Yeadon, 1987).

\[ F = k(l - l_j), \quad (S3) \]

where \( F \) = applied force (N), \( k \) = stiffness (N m\(^{-1}\)), \( l \) = original height of surface (m), and \( l_j \) = height of surface under load (m).