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Functional Properties of Equestrian Arena Surfaces: Temporal and Spatial Variations

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Horses are ridden or driven on a variety of surfaces, which differently absorb the impact forces exerted on hooves, limbs and the horse's entire body. Objective measurement of the functional properties of equestrian arena surfaces is therefore of great importance.

In Switzerland, most show jumping competitions are held on sand arenas with or without surface additives. Different arena constructions, materials, irrigation systems, maintenance management, environmental factors and the type and frequency of use influence the properties within and between equestrian arena surfaces.

The aim of the present study was to assess the sports physiological properties of ten equestrian sand arenas with and without surface additives over time (Fig. 1) and space (Fig. 2). Five of these had vertical irrigation (sprinklers, sites 1-5) and five an ebb and flow system (sites 6-10). Weekly measurements were taken at nine randomly distributed locations at each of the ten arenas for two months, using a light weight deflectometer (LWD, cover photo). Furthermore, it was investigated whether the full evaluation of the settlement curves,

including the rebound velocity of the LWD drop plate, could serve as an objective method to describe the reactivity of an equestrian arena surface.

Fig. 1: Spatial variations in the sports physiological characteristics of the equestrian arena site 2 between week 4 (left) and week 7 (right). Red lines indicate the arena's usage zones. Grey area: sampling area within which random samples were taken.

The LWD automatically generates an average value of three successive drops of the 10 kg drop plate for the dynamic deflection modulus (*Evd*, [MN/m^2]), attenuation (*s/v*, [ms]) and soil settlement (*s*, [mm]). Each drop of the LWD results in one settlement curve (penetration depth versus time).

Based on the LWD manufacturer data (ZORN Instruments GmbH), the *Evd* and *s/v* results were categorised into three classes for subsequent statistical analysis:

1) Soft equestrian arena surface: *Evd* < 10 MN/m^2; *s/v* > 6 ms,

2) Medium hard equestrian arena surface: *Evd* = 10-20 MN/m^2; *s/v* = 4-6 ms,

3) Hard equestrian arena surface: *Evd* >20 MN/m^2; *s/v* < 4 ms.

The target range for the training arenas tested in the present study was set at

Evd = 10-20 MN/m^2 and *s/v* 4-6 ms.

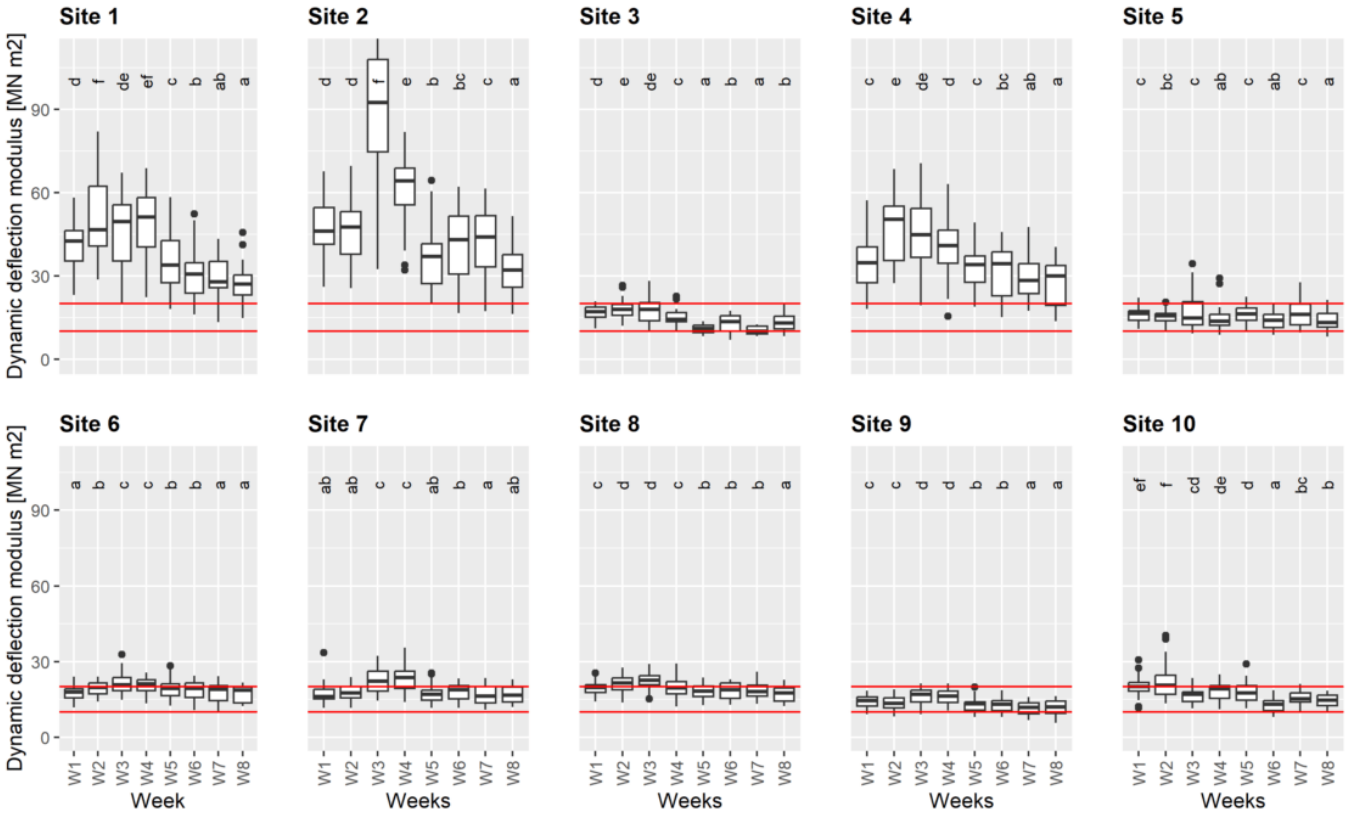

Fig. 2: Dynamic deflection modulus (*Evd*) results over 8 weeks for the 10 equestrian arenas, indicating the surfaces' hardness. The horizontal red lines indicate the target range of *Evd* = 10-20 MN/ m^2.

Main results

- Three of the five arenas with a vertical watering system were judged to be hard (Evd > 20 MN/ m^2, sites 1, 2, 4, Fig. 2) whereas all five arenas with an ebb and flow system were medium hard (Evd = 10–20 MN/m^2, sites 6-10, Fig. 2) over the entire 8-week period.
- Significant ($p<0.01$) temporal differences in Evd, s/v and moisture were demonstrated for both watering systems.
- Some arenas buffer fluctuations in humidity and climatic conditions and provide greater consistency in sports physiological properties (sites 3, 5, 6, 7, 8, 9, 10, Fig. 2).

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- Temporal consistency in the parameters over the testing weeks appears to be a criterion for arena surface stability.

- The analysis of the totality of LWD settlement curves showed that slope symmetry between impact and rebound is better suited to describing the energy recovery (reactivity) of an equestrian arena surface than only settlement. This observation requires further validation.
- In addition, the assessment of the reactivity of an equestrian arena surface would need to be related to riders' experiences as well as to injury risk and equine biomechanics.

An article by

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