MEASUREMENT TECHNIQUES AND MATERIAL BEHAVIOUR

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Introduction: Background

• Sport Surfaces represent a major part of leisure infrastructure

• Increased participation in sport has increased demands for facilities, and funding has followed

• There is a trend toward artificial surfaces replacing a large part of the natural turf market in team sports

• The introduction of a greater range of more advanced artificial surfaces, combined with an agenda in football and rugby, has led to more detailed performance related standards – to protect the users, maintain/enhance skill levels, and ensure system durability
Introduction: Background

Sports surfaces can be split into two types, artificial and natural.

Natural are defined as “surfaces formed by the suitable preparation of an area of land, which includes grass, ice, snow and loose mineral layers.

Artificial surfaces are defined as “surfaces constructed with materials which are prepared by human work, using synthetic or manufactured materials, which can include wooden boards, synthetic products or bituminous products.”
Introduction: Background

Sports surfaces can be further split into point elastic (synthetic turf, running track, cushioned foams) and area elastic (spring floors, indoor sports floors, dance floors).
Introduction: Construction

3rd generation long pile turf for soccer

- long multiple flat yarn piles
- siliceous sand infill
- shock pad – rubber or bitumen underlay
- rubber granulate infill
- backing cloth
- sub base - gravel
What Influences Test Results? **Materials**

**Sand**

**Rubber**
What Influences Test Results? **Materials**
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Why Measure?  **Safety**

To ensure the surface is safe tests are preformed.

Tests can be done to ensure the surface is for example: not too hard, slippery or that the ball will not rebound dangerously, etc...
Why Measure? Performance

To ensure the surface performs to the requirements of the sport.

This includes tests for ball-surface interactions and player surface interactions.
Why Measure? Build Quality

To ensure the surface is constructed to the required standards.

This includes tests for evenness, line markings, dimensions and other related characteristics.
Test Methods: **Ball Surface Interactions**

Surfaces are commonly measured for vertical ball bounce and ball roll.

Additionally, in tennis and football ‘surface pace’ is measured.
Test Methods: **Ball Surface Interactions**

- **Ball Rebound Height (cm)**

- **2004 Test Data**
- **FIH lower limit**
- **FIH upper limit**

Locations: Lboro, Highfields, Cannock, Bowdon, Belle Vue, Old Lought's
Test Methods: Player Surface Interactions

These includes tests for surface hardness, friction, deformation and abrasiveness.
Test Methods: **Player Surface Interactions**
Test Methods: Player Surface Interactions

Berlin Artificial Athlete: Force Reduction (%)
Test Methods: Build Quality
Test Methods: Build Quality
What Influences Test Results? **Materials**

![Graph showing force reduction (%) for different materials and specifications.](image)
What Influences Test Results? Environment
What Influences Test Results? **Environment**

Ball Rebound Height (cm)

- Dry
- Saturated
- 20 Minutes after Saturation
- 40 Minutes after Saturation
What Influences Test Results? Build Quality
What Influences Test Results? **Build Quality**
What Influences Test Results? **Build Quality**

![Graph showing stiffness (E in MPa) for different materials across rows A to G.](image)

- **Shockpad**
- **Asphalt**
- **Sub-base**

The graph illustrates the stiffness values for different materials across various rows, demonstrating the impact of build quality on test results.
What Influences Test Results? Maintenance
What Influences Test Results? Maintenance

![Bar chart showing traction (Nm) influenced by maintenance levels across different columns and rows.](image)
The Future? Research Approach

Mechanical Behaviour

Player/Surface Performance

Perceived Behaviour
The Future? Using Athlete Feedback

**BALL/SURFACE INTERACTION**

- Ball Roll
  - Speed of ball roll
  - Consistency of ball roll

- Ball Spin
  - Generated by the pitch
  - Generated by the player

- Ball Bounce
  - Ball bounce consistency
  - Angle of ball bounce
  - Height of ball bounce

**PITCH PROPERTIES**

- Generated by the pitch
  - Ball roll distance
  - Consistency of ball roll

- Pitch Consistency
  - Slope of the pitch
  - ‘Nap’ on the pitch

- Pitch Colour
  - Line markings
  - Pitch/Ball contrast

- Carpet Properties
  - Carpet pile density
  - Carpet material
  - Shockpad thickness

**PITCH PROPERTIES**

- Pitch Type
  - Game Speed

- Relationship between
  - Ball bounce and shockpad thickness
  - Game speed and ball bounce

- Effect of pile height/length on ball spin

- Effect of ‘pitch consistency on ball roll’

- Relationship between ball roll distance and carpet density

- Effect of pile height/length on ball spin

- Relationship between ball bounce and shockpad thickness
The Future? Using Athlete Feedback

$R^2 = 0.9685$

Measured Force Reduction (%) vs. Perceived Surface Hardness (1 = soft, 7 = hard)
Why don’t we test natural surfaces?
When does a fibre reinforced natural pitch become synthetic?
The Future? Better fundamental understanding

Surface Modelling?
Why don’t we measure more frequently? Once after installation, is it enough?

Regular checks will ensure:

1. Maintenance is working
2. Dangerous surface areas are identified
3. An improve understanding of durability
The Future? Research

1. Combine surface and shoe research (Stud Vs Blades debate)
2. Produce more realistic test methods
3. Identify a better understanding of the complex material interactions
4. Injury Risk?
5. Are the performance limits appropriate?
The Future? **Some things we can’t avoid!!!**
QUESTIONS?

SPORTSURF