Surface ‘Requirements’

Dr P Fleming
Loughborough University

SportSURF Launch Seminar
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Sport Surfaces

Several generations, many innovations, many products, many myths?

Natural turf vs. Synthetic – future?

Currently large investment – increasing use of artificial outdoor surfaces
Natural Turf - Football
Natural Turf - Rugby
Natural Turf - Cricket
Synthetic – Football/Rugby
Synthetic Sand-based
Athletics Track
Surface Behaviour

Component materials?
Construction Effects?
Use and maintenance effects?
Testing/evaluation?
Typical Synthetic Pitch Construction

- Synthetic turf: 11mm ± 1mm
- Shockpad: 1.2mm ± 2mm
- Upper macadam: 20mm
- Lower macadam: 40mm
- Upper sub-base: 50mm
- Lower sub-base: 200mm
- Geosynthetic layer
- Compacted fill: > 250mm
Drainable Foundation
Flat Stiff Substrate
Shockpad Construction Insitu
Synthetic Turf Carpet Laying
Carpet Types - Fill

Four generic surface types – artificial
Sand-filled (sand-dressed) carpet
Unfilled carpet (water)
Rubber crumb filled carpet
Bound rubber crumb
Many variations available…. 
Sand-filled carpet
Wet compacted sand fill
Unfilled carpet – w/based
Irrigation – regular/uniform?
Long pile carpet – rubber infill
Rubber infill
Bound Rubber - Track
Maintenance of Surfaces
Indoor Surfaces

Sports halls, multi use…

Specialist surfaces – tracks, cricket

Point elastic/area elastic
Sports Hall – Multi use
Floor Construction – Uniformity?
Cricket – Indoor Training
Athletics – Indoor Training
Testing/Evaluation

Some Examples from

Pitches, Tennis Courts, Sports hall Floors
Pitch Shockpad – Key Layer
Shockpad - Behaviour

Force - Deflection Behaviour of Carpet and 12mm Shockpad

- Model
- Force Plate Data
Shockpad – Thickness Effect

Berlin Force Reduction (%)

- In Box
- Laboratory Floor

Shockpad sample

6 mm 9 mm 11 mm 12 mm 20 mm
Carpet type – Key Layer
Carpet Fill – Key Factor
Ball Rebound – Water Drainage

Ball Rebound Height (cm)

Dry

Saturated

20 Minutes after Saturation

40 Minutes after Saturation

System
A B C D E F G H I J K L

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Non-uniform drainage
Surface Evaluation

Mechanical Measurements of ‘Performance’
Impact hardness & energy return
Friction – translation, rotation
Spatial & Temporal?
Simple tests required?
Athlete Loading Known?

Force vs. Time graph
Berlin Athlete – Impact Test

Drop height: 55cm
Drop weight: 20 kg
Test Foot: 70mm diameter

Typical Contact Pressures:
Concrete: 1700 kPa
Acrylic: 1600 kPa
Synthetic Turf: 700/800 kPa
Load pulse: ~30 milliseconds
Clegg Hammer – Impact Test

Drop height: 45cm
Drop weight: 2.5 kg (0.5kg)
Test Foot: 50mm diameter

Typical Contact Pressures:
Synthetic Turf: 1000-2000 KPa
Load pulse: ~5-10 millisecs

Useful, simple?
Berlin & 2.5kg Clegg Correlation

6 Water Based Pitches

R² = 0.97

Hard

Soft
LU Rubber Crumb
Berlin & 2.25 Clegg

Position

CLEGG

BERLIN

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W/based Pitch - Berlin Spatial Variation

![Graph of Berlin Value (N/M²) with lines for Belle Vue, Bowdon, and LU, along with a note for Thicker pad.](image-url)
Traction at Pitch F

(Algal Growth Row E)
Tennis Courts
Test Equipment: Prima Plate Test

- Drop height: up to 85 cm
- Drop weight: 10 - 20 Kg
- Pulse Time: 15 – 30 ms
- Plate Size: 100, 200 or 300 mm
- Load Range: 0 – 15 kN
- Deflection Sensor: 0 - 2200μm
- Sample Frequency: 4000 Hz
Example Heading (2)
Sprung Floors

- Sports Hall Floors
- Floor boarding and support ‘pad’ system
- Design Optimisation – trial and error
- Measure components and system behaviour
- Model the system – design optimisation
Floor – Pad & Board Effects

41 cm
Pad Support - Behaviour

(a) PE 30% Deflection
‘Performance’ Testing

Peak ‘G’ impact reaction & Berlin ‘Force Reduction’
Floor ‘Behaviour’ Testing
Floor – Bending Behaviour

Deflection Bow - Prima

Distance from Load Centre (cm)

Deflection (mm)

- Between Pads - Flr 4, 5 Rows Pads
- On Pad - Flr 4, 5 Rows Pads
- Between Pads - Flr 7, 4 Rows Pads
- On Pad - Flr 7, 4 Rows Pads
Berlin vs. Prima

$R^2 = 0.7111$
Surfaces – Other Issues

HEALTH CONCERNS

SURFACE TEMPERATURE

COSTS
HEALTH

• Constituent materials – Hazards?
• Leachate/degradation – user and environment (discharge)
• Recycled water for irrigation – risks to users?
• Organisms – effective treatment?
• Treatments – effect on products’ lifetime?
"Synthetic Surface Heat Studies"
C. Frank Williams and Gilbert E. Pulley
Brigham Young University

<table>
<thead>
<tr>
<th>Surface</th>
<th>Ave Surface Temp between 7AM &amp; 7PM</th>
<th>high</th>
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<tbody>
<tr>
<td>Art’ Soccer</td>
<td>117.38° F</td>
<td>157° F</td>
</tr>
<tr>
<td>Art’ Football</td>
<td>117.04° F</td>
<td>156° F</td>
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<tr>
<td>Natural Turf</td>
<td>78.19° F</td>
<td>88.5° F</td>
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<tr>
<td>Asphalt</td>
<td>109.62° F</td>
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<tr>
<td>Bare Soil</td>
<td>98.23° F</td>
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Safety Officer set 120° F as the maximum temperature that the surface could reach before cooling required.
COSTS (LU-2004)

<table>
<thead>
<tr>
<th></th>
<th>Water-based</th>
<th>Sand-filled</th>
<th>Rubber-crumb</th>
<th>Natural turf</th>
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<tbody>
<tr>
<td>National competition</td>
<td>46.26</td>
<td>39.00</td>
<td>25.19</td>
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<td>Club/County competition</td>
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<td>Recreational, training &amp; practice</td>
<td>41.45</td>
<td>35.97</td>
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<td>72.11</td>
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Whole-life cost

<table>
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<th>Sand fill</th>
<th>Rubber fill</th>
<th>Natural turf</th>
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<tr>
<td>£</td>
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<td>£1,730,800</td>
<td>£1,117,800</td>
<td>£555,970</td>
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(Est. on 20 year design life – top level facility)
RESEARCH NEEDS?

- Lack of coherent information/data on surface types and ‘expected’ behaviour
- No analysis of ‘Play Performance’ Test Data
- Little research into: test methods’ efficacy, design and construction, upper materials & interaction, surface effects on users
- Need coherent interaction between academics and industry
QUESTIONS?

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