1. Protecting your investment through maintenance
   *Empirical data on the effects of maintaining artificial turf fields*

2. Tackling the problem of heat
   *A pathway to solving the issue*
PROTECTING YOUR INVESTMENT THROUGH MAINTENANCE

Empirical data on the effects of maintaining artificial turf fields
Aim
• Prevailing view: no maintenance needed
• 2 objectives
  o Define what sort of maintenance is the most effective
  o See effect on playing performance and safety

Protocol
• 7 artificial turf fields in Western France
  o Rennes: Square de Berry, Stade Salengro
  o Laval: Gandonniere, Hippodrome
  o Le Mans: Fontennelle
  o Angers: Stade de l’Arceau, Bertin
## Protocol

### Testing Procedure vs Maintenance Effect on System Component

<table>
<thead>
<tr>
<th>Testing Procedure</th>
<th>Maintenance Effect on System Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball Rebound</td>
<td>Performance Infill and Fibres</td>
</tr>
<tr>
<td>Ball Roll</td>
<td>Fibres</td>
</tr>
<tr>
<td>Force Reduction</td>
<td>Performance Infill</td>
</tr>
<tr>
<td>Deformation</td>
<td>Performance Infill</td>
</tr>
<tr>
<td>Energy Restitution</td>
<td>Performance Infill</td>
</tr>
<tr>
<td>Rotational Resistance</td>
<td>Performance infill and fibres</td>
</tr>
</tbody>
</table>

### 3 tests: prior to maintenance, directly after maintenance, 1 month later
4 DIFFERENT TECHNIQUES

Oscillating Brush

Rotary Brush

Brush & Rake

Trinangular Brush
Maintenance

- Field divided into 4 quadrants
- Each technique responsible for one quadrant
## CLIMATIC CONDITIONS FOR TEST

<table>
<thead>
<tr>
<th>Date</th>
<th>1.7.2013</th>
<th>2.7.2013</th>
<th>7.8.2013</th>
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</thead>
<tbody>
<tr>
<td>Surface Temp.</td>
<td>24.1°C</td>
<td>22°C</td>
<td>27.9°C</td>
</tr>
<tr>
<td>Humidity</td>
<td>58.1 %</td>
<td>51 %</td>
<td>69 %</td>
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<tr>
<td>Surface condition</td>
<td>Dry</td>
<td>Dry</td>
<td>Dry</td>
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</tbody>
</table>
RESULTS
## BALL ROLL

<table>
<thead>
<tr>
<th>Test Position</th>
<th>1. Test</th>
<th>Maintenance</th>
<th>2. Test</th>
<th>No maintenance</th>
<th>3. Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.96</td>
<td>↓</td>
<td>10.42</td>
<td>↑</td>
<td>11.91</td>
</tr>
<tr>
<td>2</td>
<td>12.02</td>
<td>↓</td>
<td>10.79</td>
<td>↑</td>
<td>13.21</td>
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<tr>
<td>3</td>
<td>12.36</td>
<td>↓</td>
<td>10.14</td>
<td>↑</td>
<td>13.67</td>
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<td>4</td>
<td>12.24</td>
<td>↓</td>
<td>10.7</td>
<td>↑</td>
<td>13.07</td>
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<td>5</td>
<td>12.75</td>
<td>↓</td>
<td>11.204</td>
<td>↑</td>
<td>13.23</td>
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<tr>
<td>6</td>
<td>12.02</td>
<td>↓</td>
<td>10.16</td>
<td>↓</td>
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<tr>
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<td>10.86</td>
<td>↓</td>
<td>9.93</td>
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<td>12.42</td>
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<tr>
<td>8</td>
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<td>10.99</td>
<td>↑</td>
<td>14.32</td>
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<td>↑</td>
<td>13.63</td>
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<tr>
<td>10</td>
<td>11.74</td>
<td>↓</td>
<td>10.65</td>
<td>↑</td>
<td>13.17</td>
</tr>
</tbody>
</table>
BALL ROLL

- Significant changes recorded
- Oscillating brush generates the overall relative average change
- Least effect with Triangular brush
- After 1 month increase of values for 3 machines
• No differences between the machines
• Only small increase of results (lower ball rebound)
• Without maintenance, shock pads have an influence on ball rebound
• No consistency between results
• Less resistance on 5 fields due to the loosened infill
• 2 fields with increased Rotational Resistance
• Studs penetrating into the sand layer
• Loose infill is a temporary effect
• All values fulfil the FIFA requirements
DEFORMATION

• Discrepancy between different fields
  o Largest relative decrease of -11.2 %
  o Largest relative increase of 5.99 %

• Drag brush & rake with greatest overall change (average of -3.08 %)
  o Max: -11.2 %
  o Min: 1.9 %

• After 1 month deformation remains negative
• Consolidating of the infill for most systems
CONCLUSION

- Maintenance improves performance and safety immediately after maintenance

- Without continuing maintenance only minor long-term effects

- Most significant effect with all machines on ball roll: impact on speed of the game
WHAT DOES THIS MEAN FOR MY FIELD?

• Regular maintenance is essential for the Playing performance and safety
  o Frequency depends on the playing hours

• Special machineries have a bigger influence on special values
  o Oscillating brush on Ball Roll
  o Drag brush & rake on Deformation

• Shock pads might have a positive influence on the Ball Rebound
Tackling the Problem of heat

A pathway to solving the issue
Why study heat?

• Commonly perceived issue
• Results from the player perception survey
• Affects player safety
• Affects player performance
• Has been a research priority since 2011
Methodology and parameters

• Get reliable data on temperature occurring on football turf
• Determine influence of materials on heat build-up
• Analyse different points of measurement within the sample

• **Aim:** get a reproducible methodology
Methodology

- Climatic chamber
- 24 hour cycle
- Established standard: MIL-STD-810 505.5
- Choice of hot dry climate (A2)
  - Ambient air temperature 30-43°C
  - Relative humidity 14-44%
  - Solar radiation 0-1120 W/m²
Samples

• TEST 1: surfaces
  Data from 8 different surfaces including natural, unfilled and filled

• TEST 2: infills
  Standard 60mm monofilament with 11 different infills

• TEST 3: yarns/carpets
  9 different carpets all filled with same sand and SBR
Results

• The methodology can be used as means to classify systems

• Results are most significant 5mm below the infill

• There are significant differences between systems in all three tests
  • Surface temperature between 41°C and 80°C
  • Type of infills vary between 41°C and 69°C
  • Type of turf vary between 57°C and 66°C
Results – example of graph
Results – example of graph
Results – example of graph

Test 3 - Infills comparison - Basic hot conditions A2 - Infills surface temperature

Ambient T°C
- S3-60 mono SBR soil
- S10-60 mono Mix (SBR+sand)
- S11-60 mono SBR+cork layer
- S12-60 mono SBR+ TPE layer
- S13-60 mono EPDM2
- S14-60 mono TPE1
- S15-60 mono TPE2
- S16-60 mono Orga dry
- Irradiance

Irradiance W/m²
- S5-60 mono EPDM
- S6-60 mono SBR coated
- S10-60 mono Mix (SBR+sand)
- S11-60 mono SBR+cork layer
- S12-60 mono SBR+ TPE layer
- S13-60 mono EPDM2
- S14-60 mono TPE1
- S15-60 mono TPE2
- S16-60 mono Orga dry

Hour of the day (hour)

Temperature °C

20.00 25.00 30.00 35.00 40.00 45.00 50.00 55.00 60.00 65.00 70.00 75.00 80.00 85.00 90.00 95.00 100.00 105.00 110.00 115.00 120.00

0.00 200.00 400.00 600.00 800.00 1000.00 1200.00
Results – example of graph

Test 4: Turfs comparison - Basic hot conditions A2 - Infills surface temperature

- S17 - 60 mono2 flat sand+SBR
- S18 - 60 mono3 flat sand+SBR
- S19 - 60 mono4 flat sand+SBR
- S20 - 60 mono5 "S" sand+SBR
- S21 - 60 fibrilated sand+SBR
- S22 - 60 twisted sand+SBR
- S23 - 65 mix mono+fib - sand+SBR
- S24 - 65 mix mono+fib - sand+SBR
- S3 - 60 mono1 sand+SBR

Irradiance

Temperature °C

Hour of the day (Hour)
Results – example of outcome
What does this tell us

- Results allow classification of systems

<table>
<thead>
<tr>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
<th>Category 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 46°C</td>
<td>46-55°C</td>
<td>56-62°C</td>
<td>63-70°C</td>
<td>&gt; 70°C</td>
</tr>
</tbody>
</table>
Why choose this approach?

- Not every user may see heat as the same problem
- Tenders can indicate categories according to priority
- Guidance for the buyer
- Encouragement to develop cooler systems

"Think of it like the EU energy efficiency label"
When and how?

- Test method to be part of manual 2014
- Every lab report must include this test result
- Every product declaration (specs sheet) must indicate heat category
- FIFA method will be made available beforehand
- Key: sample preparation
QUESTIONS

or mail: quality@fifa.org
Thank you