Shear Wave Velocity Determination of Peat

ET Hanrahan Memorial Symposium
Shear Wave Velocity Estimates of Peat
Introduction

Research Masters – Geophysical Determination of Peat Strength

Aim of Research:
- Determine if a robust relationship exists between peat strength and seismic parameters
- Develop a methodology for measuring peat strength in-situ

Schedule (part time):
- Literature review
- Initial testing – establish limitations of equipment
- Field testing – determine Vs values in-situ
  - collect Von Post data
  - collect water content samples
  - collect samples for DSS testing
- Laboratory testing – assess water content for correlation with Vs dataset
  - assess Su for correlation with Vs dataset
- Write up
Previous Work

MINERAL SOILS

Relationship between Su of DBC and Vs from MASW tests

PEAT

Relationship between Su derived from Shear Vane Tests and Vs

"studies are incomplete because of the scarce technology and poor techniques.....a satisfactory solution has not yet been achieved"

LONG 1993

AMARYAN 1993
Seismic Waves

**P-wave**
- Fastest; Compressional
- Particle motion parallel to direction of propagation

**S-wave**
- Shearing and rotation
- Particle motion perpendicular to direction of propagation

Shear Modulus (G) \[ G = \rho V_s^2 \]

**Surface waves**
- Raleigh or Love type
- Largest amplitude
- Propagate along surface
- Elliptical particle motions
Initial Field Trials

Upland peat site.
County Tyrone
GPR carried out for peat thickness
highly variable thickness
Access by 8WD vehicle

1) Direct Shear Wave Transmission
2) Multi channel Analysis of Surface Waves (MASW)
3) Downhole Shear Wave Transmission
Downhole Shear Wave
Downhole Shear Wave

Time (ms)

\[ \Delta d \text{ (mm)} \]

\[ V_s = 23 \text{m/s} \]

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Direct Shear Wave Propagation

$V_s = 24.7 \text{m/s}$
Multichannel Analysis of Surface Waves - MASW

Vs = 21-24 m/s

Too shallow to resolve

Clay below Peat
Conclusions

<table>
<thead>
<tr>
<th>METHOD</th>
<th>MEASURED Vs</th>
<th>NOTES</th>
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<tbody>
<tr>
<td>Vs Direct</td>
<td>24.7</td>
<td>Vs will trend towards upper limit thin layers will not be resolved</td>
</tr>
<tr>
<td>MASW</td>
<td>21 – 24</td>
<td>software derived profile (accuracies for peat not fully understood) upper layers not resolved due to frequency limitations</td>
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<tr>
<td>Vs Downhole</td>
<td>23 (below 0.5m)</td>
<td>lower values recorded at near surface need to be investigated further. correlation to peat sampling required to assess relative variations correlation to DSS tests required to assess relationship to strength limit of method with respect to thin layers needs to be assessed (can we resolve thin layers of weak peat?)</td>
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The measurement of Vs in the field is practical.
The correlation between the different techniques is good (low scatter)
With the correct geometry relatively thin layer should be resolvable (Downhole)
The Next Year And A Half

DEVELOP EQUIPMENT (downhole technique)
  repeatability
  time referencing
  establish limitations and precision
  frequency dependency

FURTHER FIELD TRIALS
  upland blanket bog
  production bog
  raised bog

RELATE FIELD DATA TO LAB TEST RESULTS – DSS and water content

ESTABLISH ENGINEERING RELATIONSHIPS
  $V_s$ and UNDRAINED SHEAR STRENGTH
  $V_s$, Water Content and UNDRAINED SHEAR STRENGTH

ANISOTROPY – $V_{svh}$, $V_{shv}$ and $V_{shh}$
The Main Obstacle to Overcome

*Culicoides impunctatus*

‘the biting midge’