

Multichannel Analysis of Surface Waves: Applications and Developments

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Introduction

- n NDT Research at UCD
- n Surface Waves
- n Multichannel Analysis of Surface Waves (MASW)
 - n Introduction
 - n Applications
- n Summary



Engineering Geophysical Research, UCD

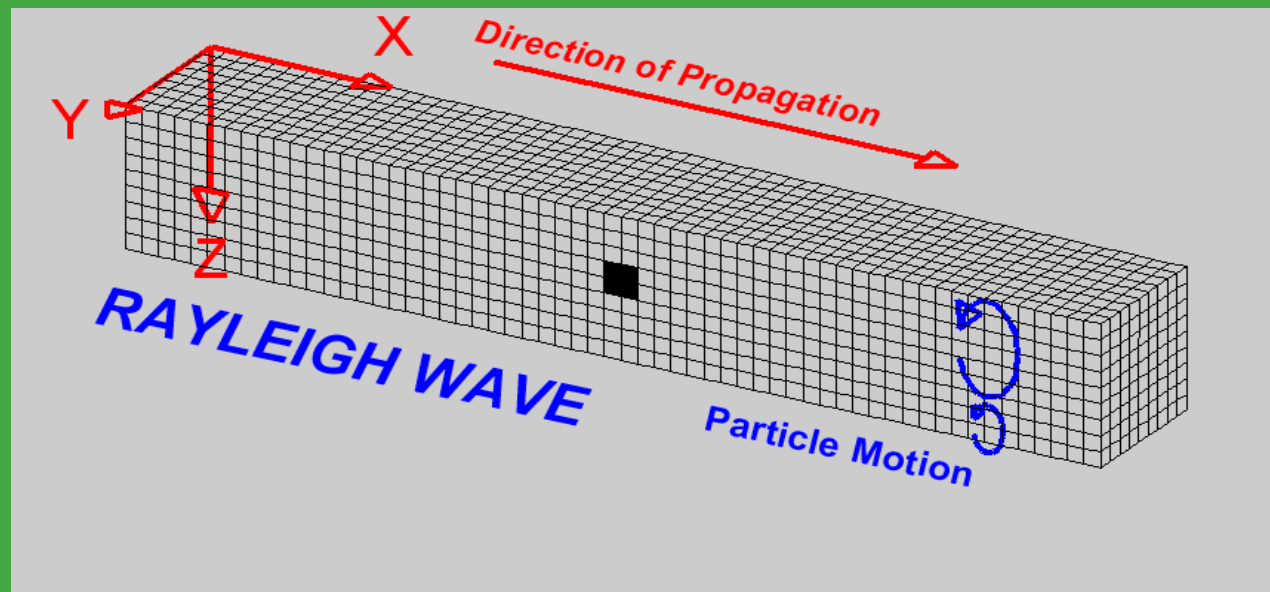
- n Non-destructive, cost effective solutions to geotechnical and infrastructure problems
- n MASW, Seismics, Resistivity, GPR, Microgravity
- n UCD research applications:
 - n Slope stability (natural & man-made) assessment
 - n Parameters for geotechnical design
 - n Ground improvement
 - n Karst Detection
 - n Pavement Quality Assurance
 - n Railway Ballast degradation



Surface Wave Techniques

n CSW, SASW, MASW

- n Surface Wave / Lamb Wave propagation
- n Elastic stiffness & thickness
- n Differences in source / receivers / inversion
- n MASW “Pattern Recognition” technique
- n Extraction of noise and different modes of surface wave propagation

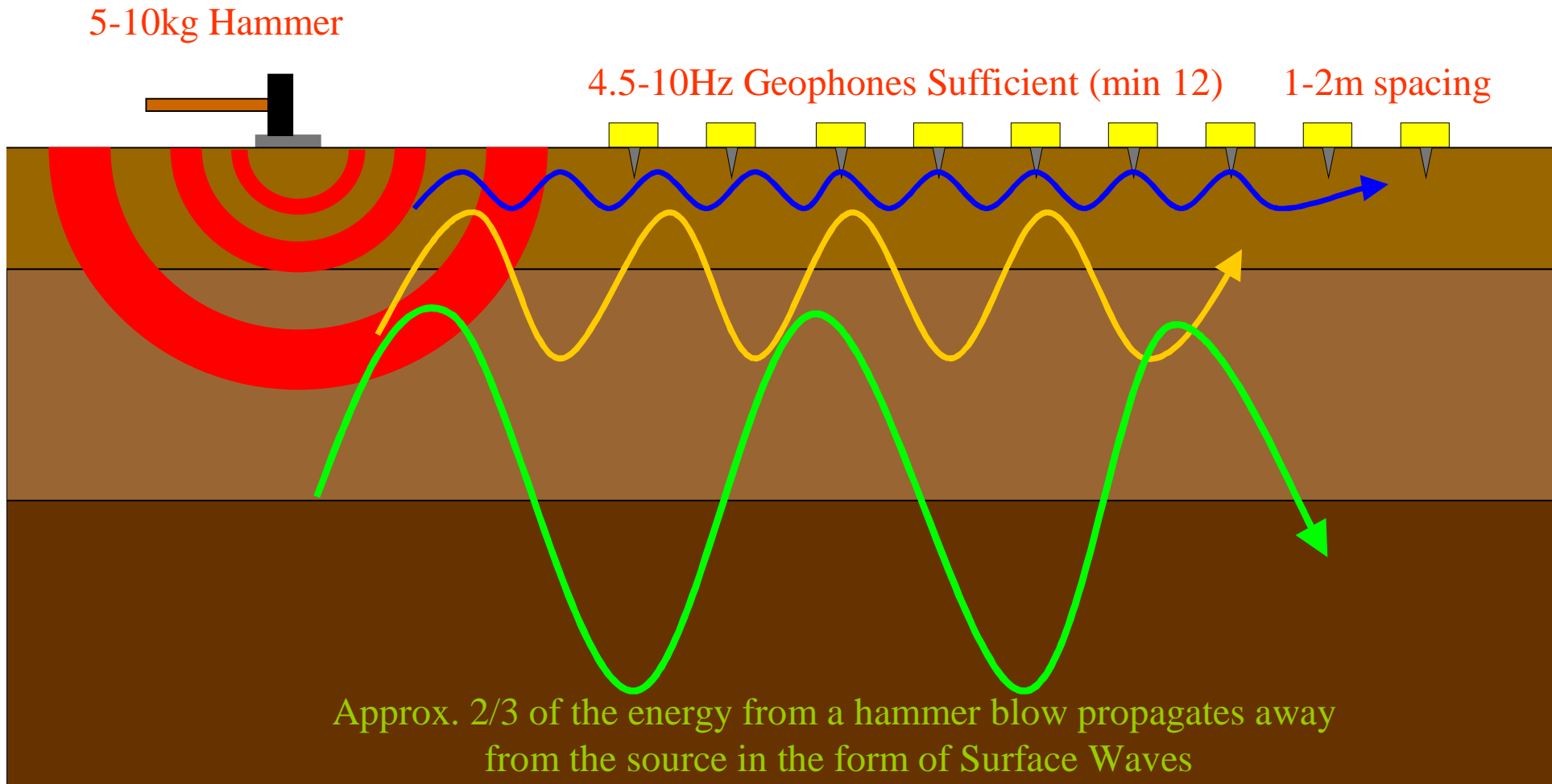


General Methodology: MASW

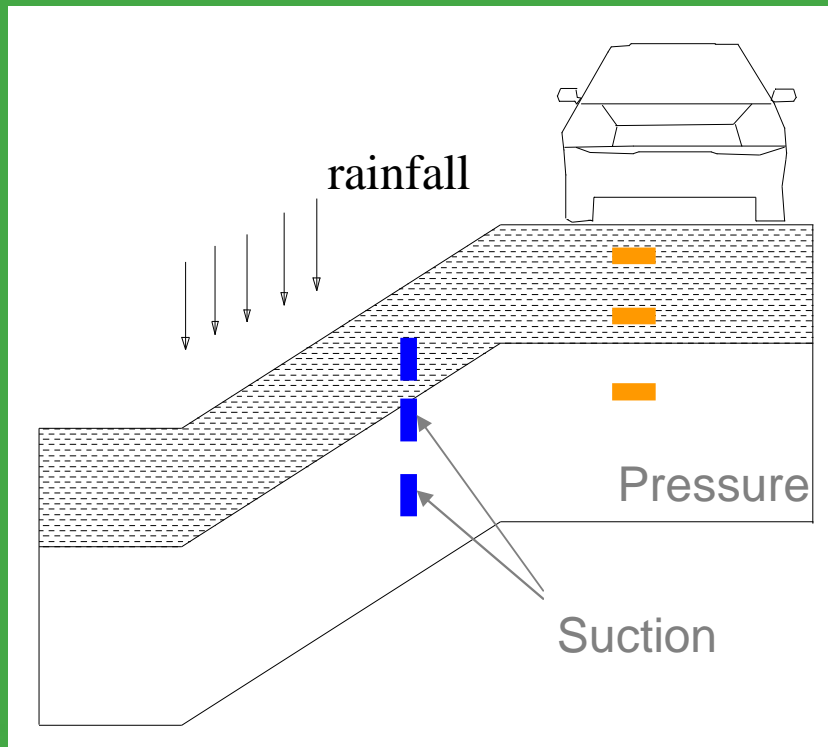
- (1) Generate vertical ground motions
- (2) Detection and Measurement of Surface Wave
- (3) Record the Surface Wave
- (4) Produce a dispersion curve
- (5) Inversion of the dispersion curve



Multichannel Analysis of Surface Waves (MASW)



Stability of Earth Embankments

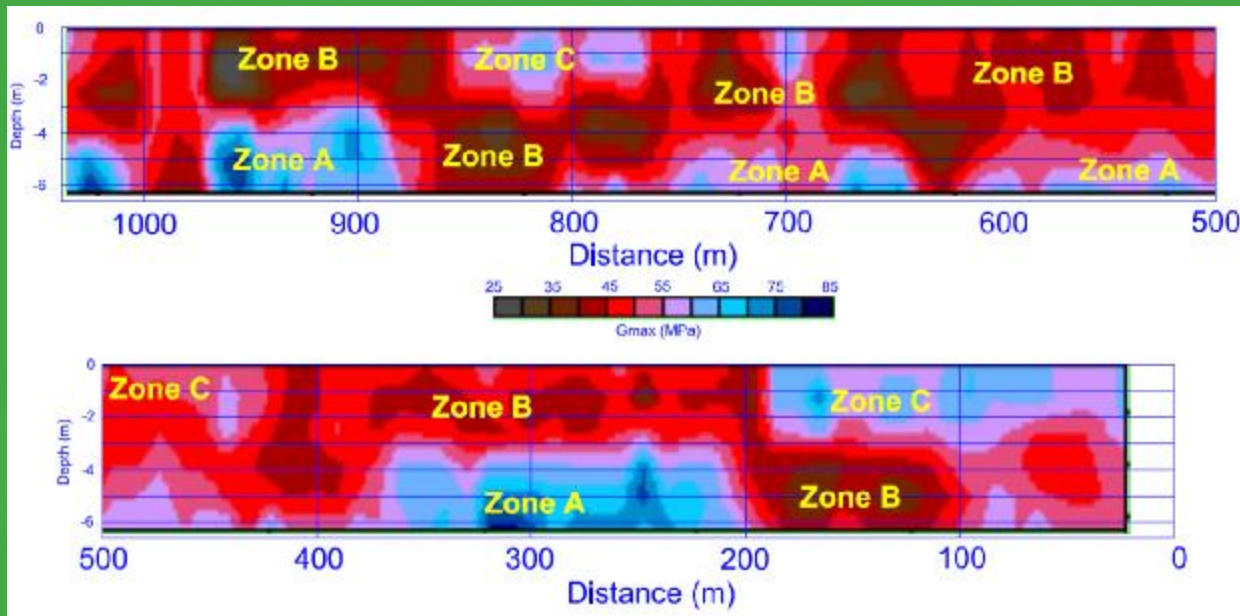


- n In-situ monitoring of water content and applied traffic stresses
- n We cannot monitor every slope, we need to identify critical sections
- n Geophysical NDT for real time assessment of infrastructure reliability

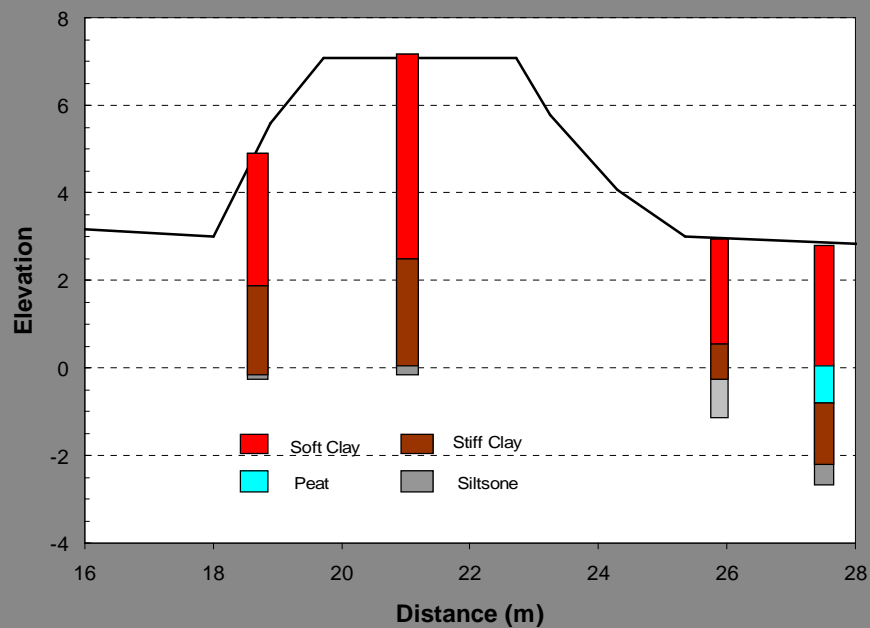
Embankment Stability Assessment, River Dee Flood Defences, Chester

Multichannel Analysis of Surface Waves (MASW)

- n 2D stiffness mapping
- n Identify soft ground within embankment
- n Identify geological boundaries



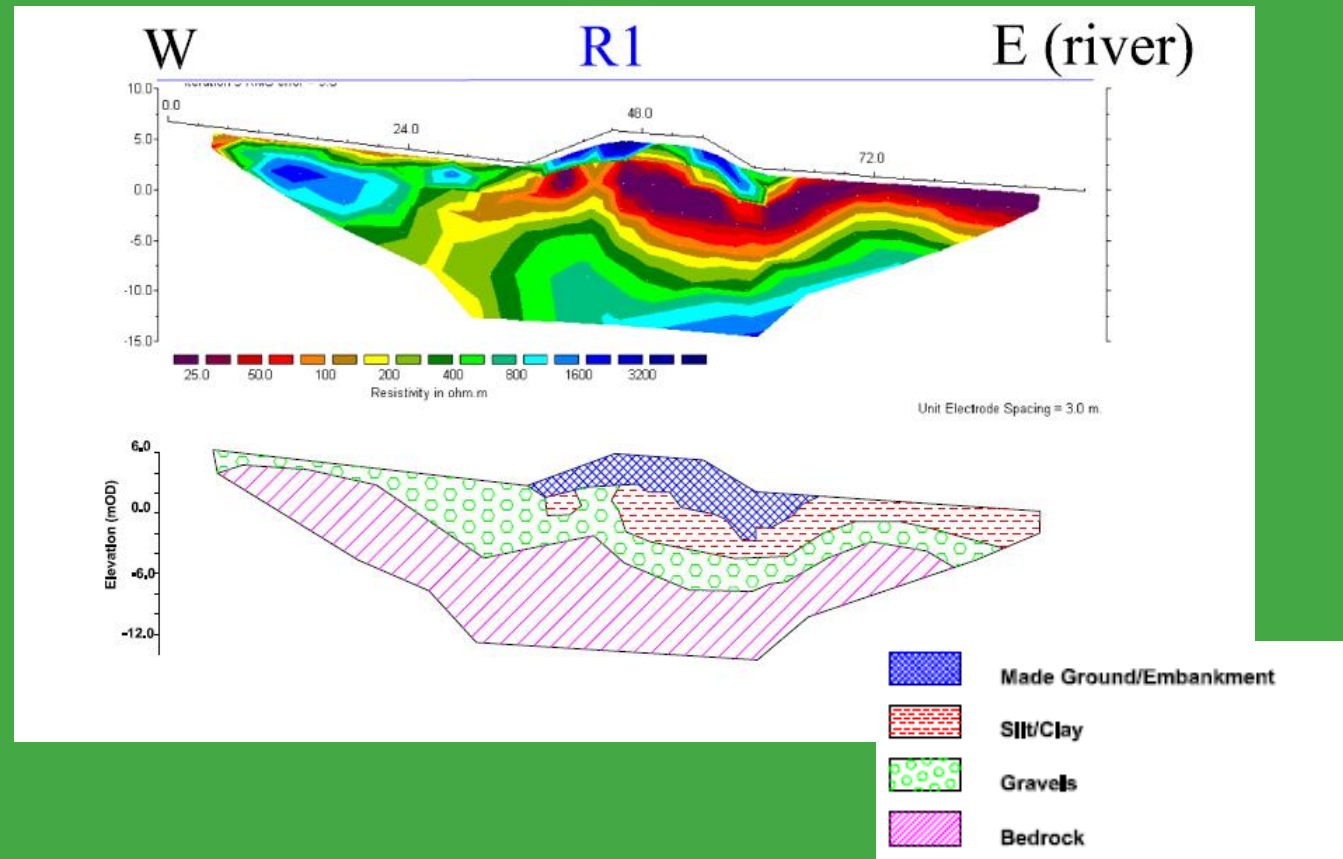
Railway Embankment Failure, Enniscorthy, Co. Wexford



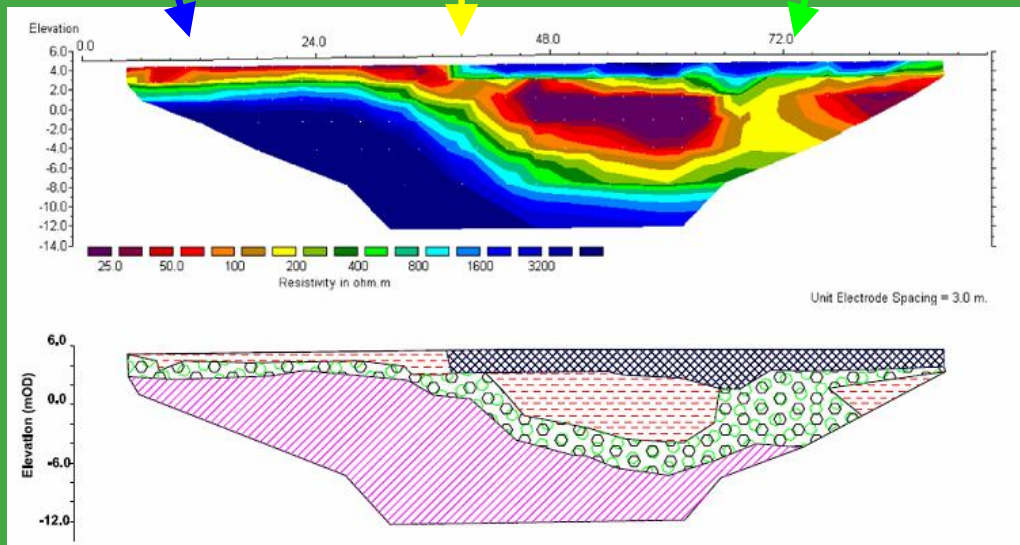
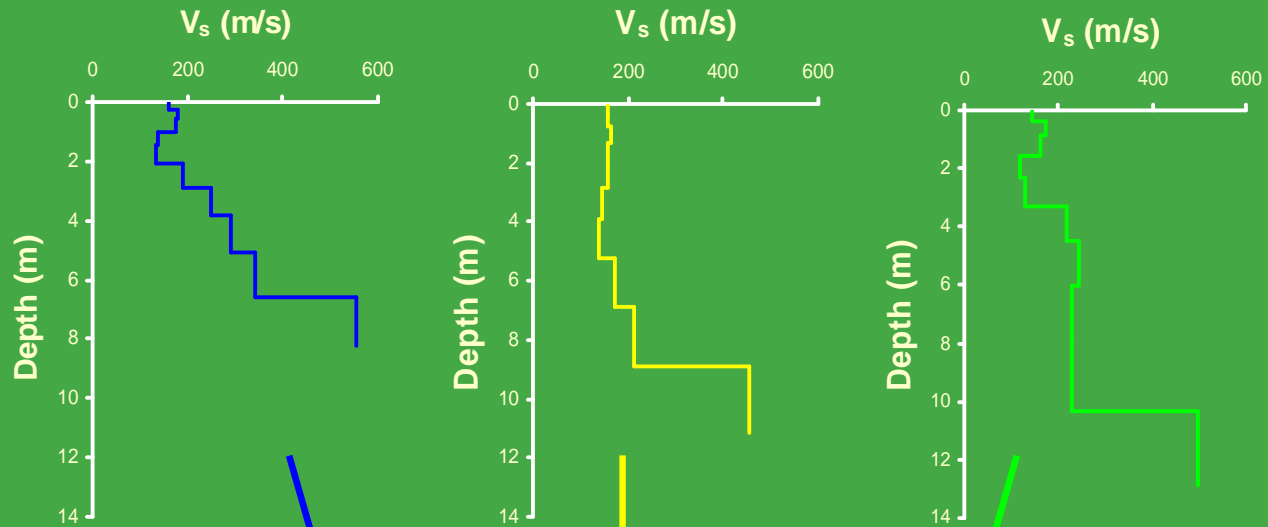
Cross-Section



2D Resistivity across track through failure plane



2D Resistivity & MASW along track



Ground Improvement Quality Control

MASW


- n Quantify improvement in terms of small strain stiffness
- n Non-invasive
- n Direct and Rapid measure of improvement

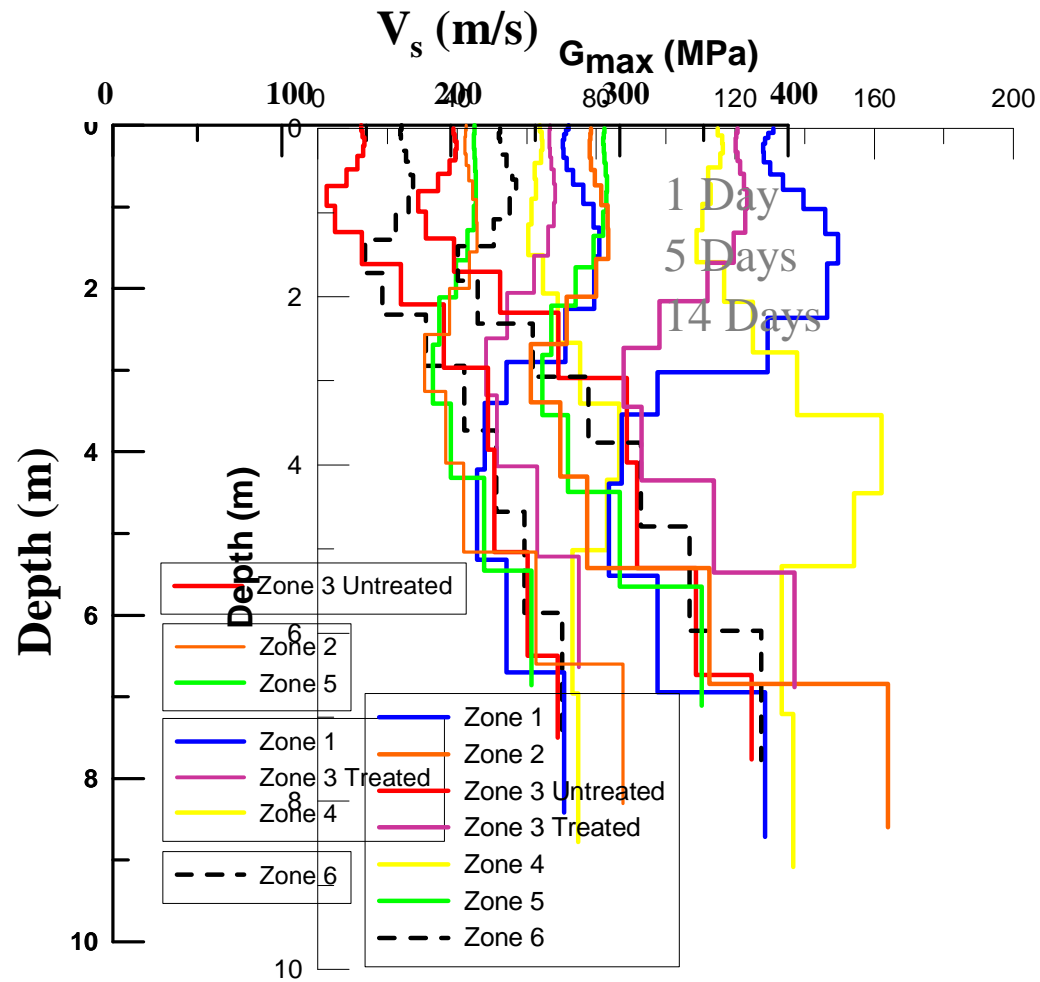
Jamaica St., Belfast

- n Excavation of unsuitable material (2-4m)
- n Treated with Lime
- n Compacted



Jamaica St. site, Belfast

$$G_{\max} = \rho \cdot V_s^2$$




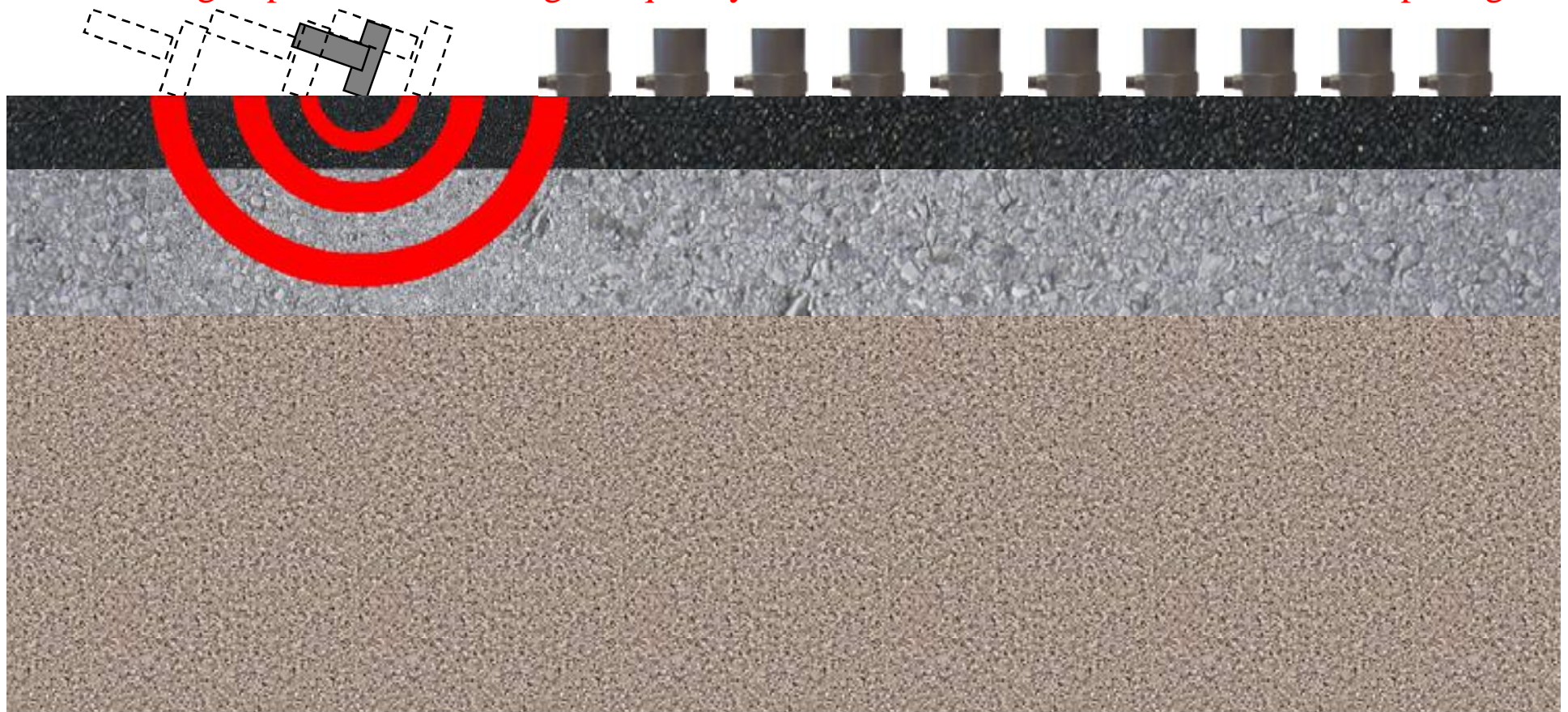
Pavement MASW

MSOR (Ryden et al. 2001)

200g impact hammer

High frequency accelerometer

~0.1m spacing



Source and Receivers



Impulse Force Hammer

- n Integral quartz force sensor
- n Superior triggering
- n Selection of tips



High frequency accelerometers

- n Natural frequency – 25kHz
- n Mount with grease

UCD Pavement MASW

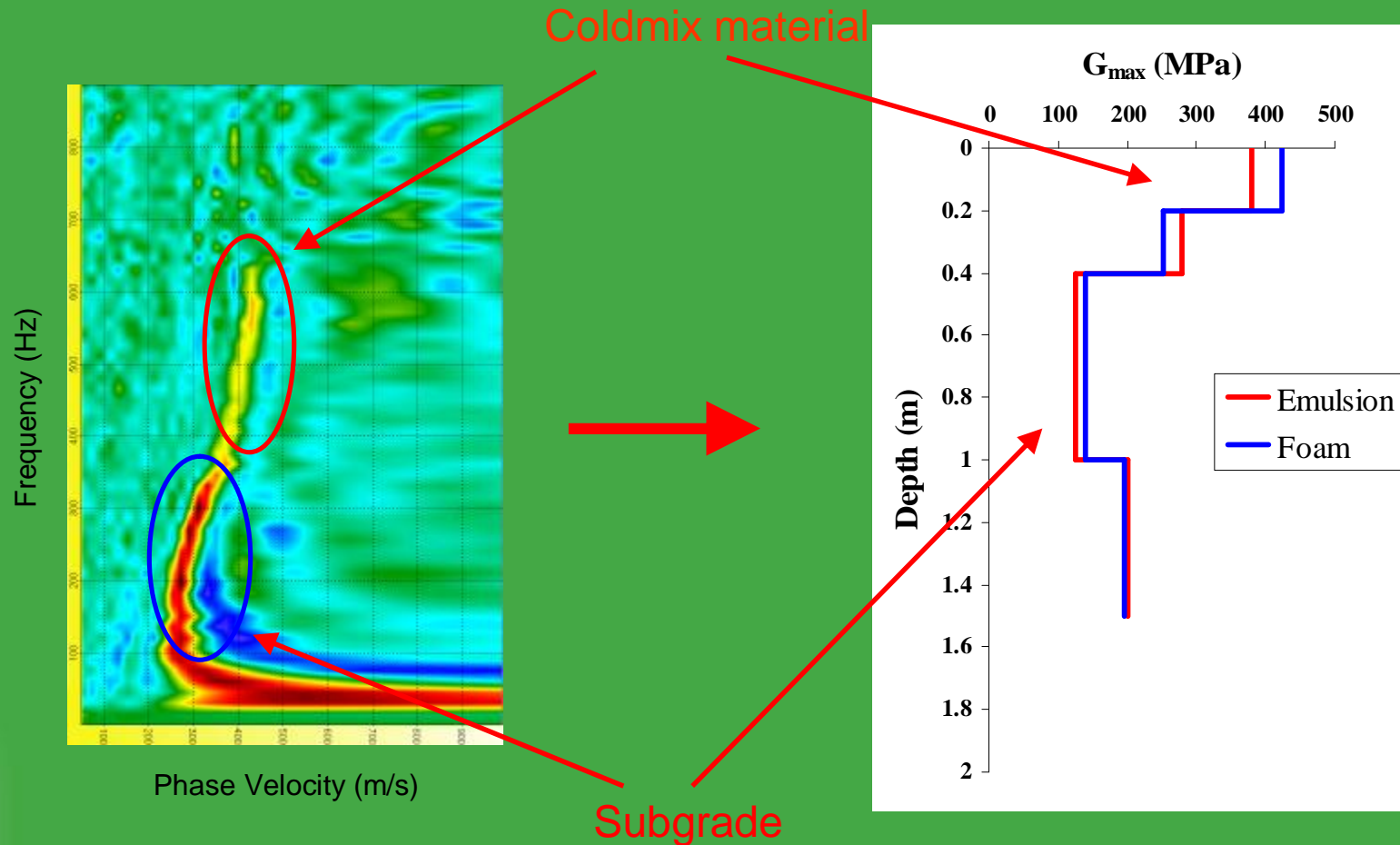
- n “True” Multichannel system
- n Quicker
- n Eliminates need for Time break corrections

Performance of Coldmix Pavement Materials

- n Cheaper and more Energy Efficient in construction (cost and sustainability)
- n Review of cold-mix materials, laboratory trials of different mix specifications, and full-scale trials
- n MASW for quality assurance
- n Funded by National Roads Authority (NRA)



MASW feasibility trial at National Roads Authority (NRA) test site, Dublin



Surface wave "dispersion image"

Pavement stiffness profile

Summary

- n Surface wave techniques for measurements of elastic stiffness and layer thickness
- n MASW geotechnical and pavement applications
- n UCD “true multichannel” system for quicker acquisition without need for corrections



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- n CON-FORM
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- n Thank you!

