DEEP FOUNDATIONS INSTITUTE DFI

in partnership with ADSC

# SuperPile'22

## Piling Design & Construction Conference

St. Louis, Missouri

June 15-17, 2022 | Hilton St. Louis at the Ballpark



## Panel Discussion: Horses for Courses – Testing of Unknown Foundations

**Moderator**: Gerald Verbeek • Allnamics

**Panelists**: Bernie Hertlein • GEI Consultants

Dennis Sack • Olson Engineering





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**Moderator**: Gerald Verbeek • Allnamics

**Panelists**: Travis Coleman • GRL

Dennis Sack • Olson Engineering





# Panel Discussion: Horses for Courses




**Horses for Courses:**
The practice of choosing
the best person for a particular job,
the best response for a situation,
or the best means to achieve a specific end.

For this panel discussion:
the most appropriate testing method
for a given situation

# Panel Discussion: Horses for Courses

Paper presented at International Conference on Piling and Deep Foundations
London - March 1987

Authors: Huw T. Williams, Senior Technician, and
Richard T. Stain, Director
Testconsult CEBTP Ltd., Warrington, Cheshire.

Title: "Integrity Testing of Piles -- Horses for Courses"

**It is now some 20 years since non-destructive tests were first used as a means of quality control for piled foundations. During this time new methods have evolved and old methods have developed, largely due to advances in micro-processing.**

**But despite these undoubted technical advances and the increasing popularity of such methods, many engineers are unaware of their inherent limitations and cannot therefore choose the technique best suited to their requirements. All too often the choice of method will be dictated by cost alone.**

**All test methods, however, have limitations and it is only by being aware that the engineer can specify an appropriate test programme.**

# Panel Discussion: Horses for Courses

More than 30 years later this is still valid, and in a way the situation is more complex as there are now even more horses to choose from.

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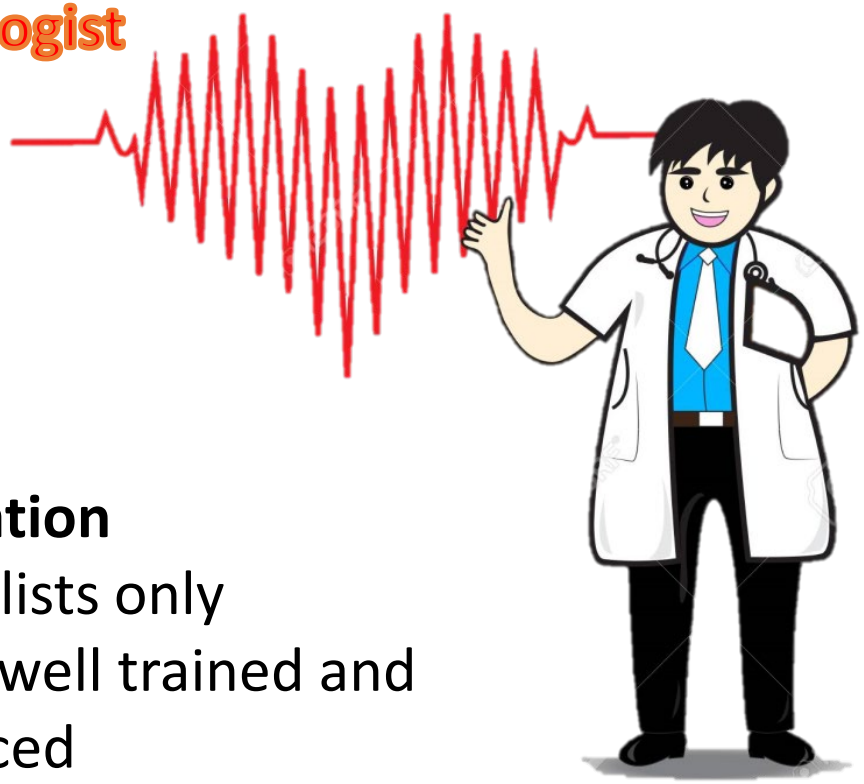






# Panel Discussion: Horses for Courses

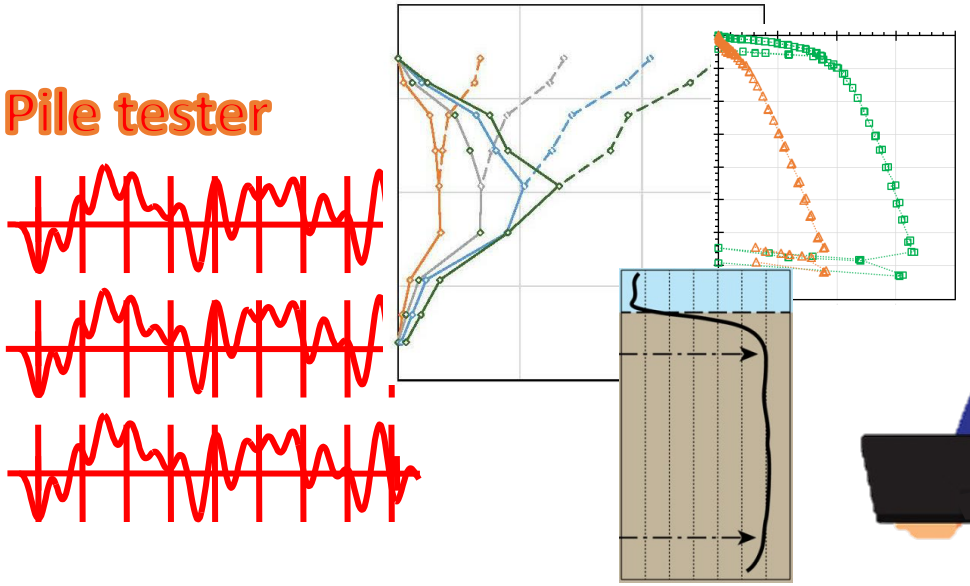
## Cardiologist



**Interpretation**

- By specialists only
- Who are well trained and experienced
- Supported (and not led) by IT
- Independent, results are NOT influenced by who is hiring

## Pile tester





**Interpretation**

- By specialists only
- Who are well trained and experienced
- Supported (and not led) by IT
- Independent, results are NOT influenced by who is hiring

# Panel Discussion: Horses for Courses

**Introduction of Potential Testing Methods**:

Dennis Sack • Unknown Foundation Evaluation Overview

Travis Coleman• Non-destructive Testing Method Details





# Panel Discussion: Horses for Courses






- After the panelists have given a brief opening statement there will be a moderated Q&A session
- If you have a question please use the app at any time during the presentations or the Q&A

# Panel Discussion: Horses for Courses – Geophysics

## Unknown Foundation Evaluation Overview

Dennis Sack – Olson Engineering



# Panel Discussion: Horses for Courses – Geophysics

**Unknown Foundation Evaluation – Needs**

Foundation Length for Re-use or added load

Foundation integrity

Foundation type determination

Foundation material information

Foundation location (under grade beams/pile caps)

Ancillary foundation information – rebar type and spacing, anchor bolt length and integrity, foundation diameter, pile cap thickness, etc.

# Panel Discussion: Horses for Courses – Geophysics

**Unknown Foundation Evaluation – Typical Foundation Types**

Drilled Shafts

Timber Piles

Steel H-Piles

Pipe Piles

Precast Concrete Piles

Mat Foundations

Complex Foundations (Buried Pile Caps, Combined Foundations, etc.)

Footer and Other Shallow Foundations

# Panel Discussion: Horses for Courses – Geophysics

Available Test Methods -

Common methods:

- Echo Testing (Pile Integrity Testing, Sonic Echo, Impulse Response, etc.)
- Parallel Seismic Testing (new ASTM standard)

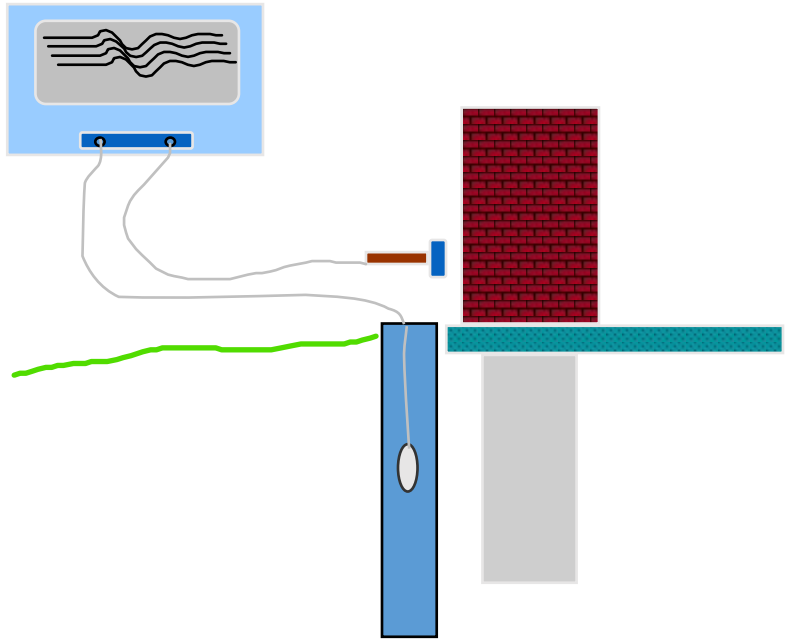
Specialized Methods

- Downhole Magnetic and Electromagnetic Tools (EM and MAG)
- Ground Penetrating Radar (GPR)
- Spectral Analysis of Surface Waves (SASW)
- Borehole Radar (BR)

# Panel Discussion: Horses for Courses – Geophysics

Parallel Seismic Method

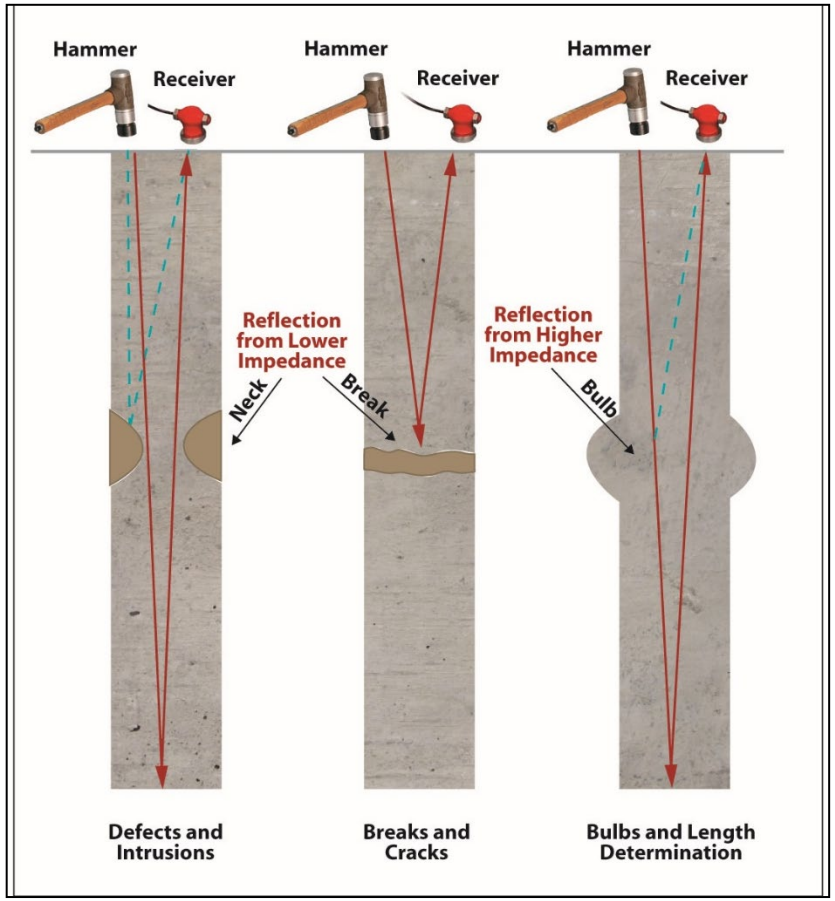
- Measures length
- Identifies material
- Can be used on existing structures
- Needs access tube beside structure
- Slower than Echo Testing



# Panel Discussion: Horses for Courses – Geophysics

Echo Testing Methods

- Measures length
- Detects and located defects
- Can be used on existing structures
- Usually requires direct foundation access
- Relatively fast method



# Panel Discussion: Horses for Courses – Geophysics

Specialized Methods Overview

- GPR – Used for mat foundations, spread footer evaluation, and other “shallow” foundations. Also used for rebar evaluations
- EM and Mag – Requires a borehole installed next to foundation, can measure steel pile depths very precisely. Can also measure depth of rebar cages
- SASW – Used for lateral and shallow foundation evaluations
- BR – Requires a borehole installed next to the foundation, works best on steel foundations

# Panel Discussion: Horses for Courses – NDT

## Details NDT Methods For Assessment of Unknown Foundations

Bernie Hertlein – GEI Consultants

GEI Consultants

# Panel Discussion: Horses for Courses – NDT

**What are the most common nondestructive unknown foundation tests that are commercially available?**

- Crosshole Sonic Log: Requires access tubes in the foundation.
- Gamma/gamma Log: Requires access tubes in the foundation.
- Thermal Integrity Profile: Monitors heat of hydration in fresh concrete.
- Impulse-Echo/Impulse Response: Requires access to the foundation.
- Parallel Seismic: Requires a borehole beside the foundation

# Panel Discussion: Horses for Courses – NDT

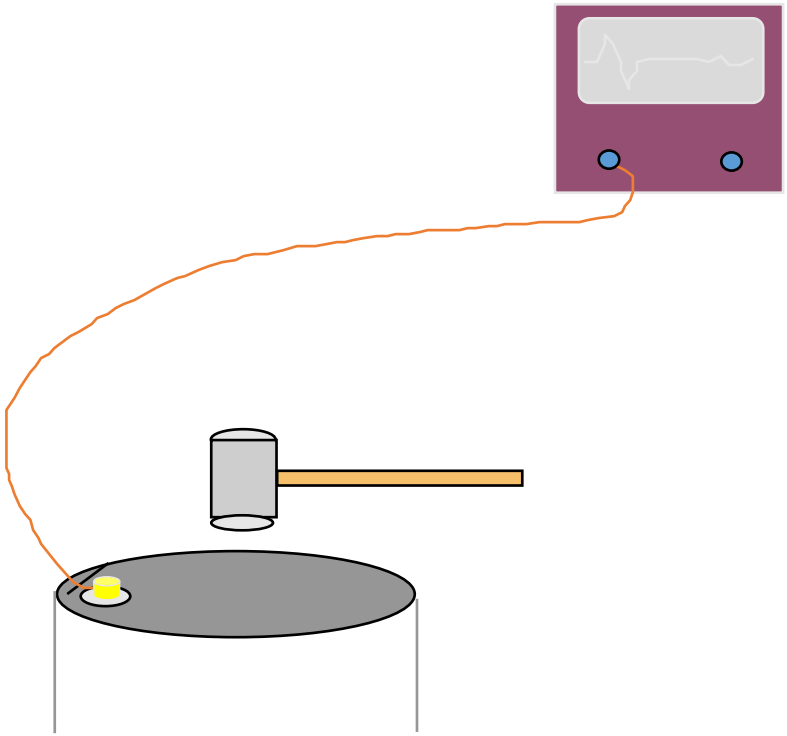
**What will work for unknown foundations?**

- Crosshole Sonic and Gamma/gamma logging both require access tubes in the foundation, so usually cannot be applied to existing foundations, unless core-holes are drilled.
- Thermal Integrity Profile monitors heat of hydration, and therefore provides no useful information after the concrete has cooled to ambient soil temperature.
- Impulse-Echo and Impulse Response both require direct access to the foundation, and both work best if the head of the foundation is exposed.
- Parallel Seismic does not require direct access to the foundation but does require a borehole in the soil parallel and close to the foundation, and an impact point either on the foundation or on the structure directly above it.

# Panel Discussion: Horses for Courses – NDT

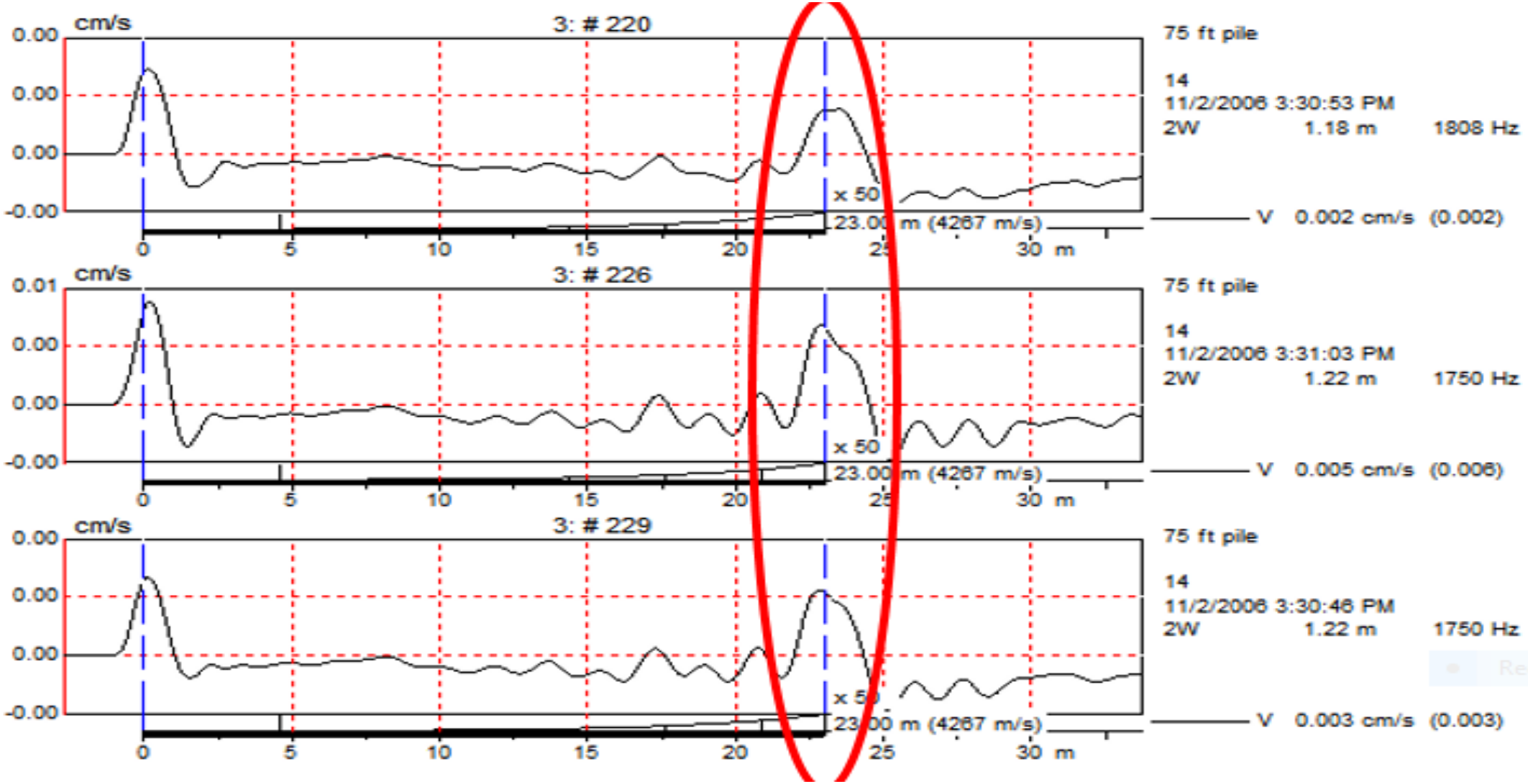
Impulse Echo Method – ASTM D5882
(Also called Pile Integrity Testing, PIT or Sonic Echo, SE)

- Developed for pre-cast  driven piles
- Very fast and economical
- Only measures time
- Not good in complex  soils or with variable shaft cross-section
- Limited penetration depth



# Panel Discussion: Horses for Courses – NDT

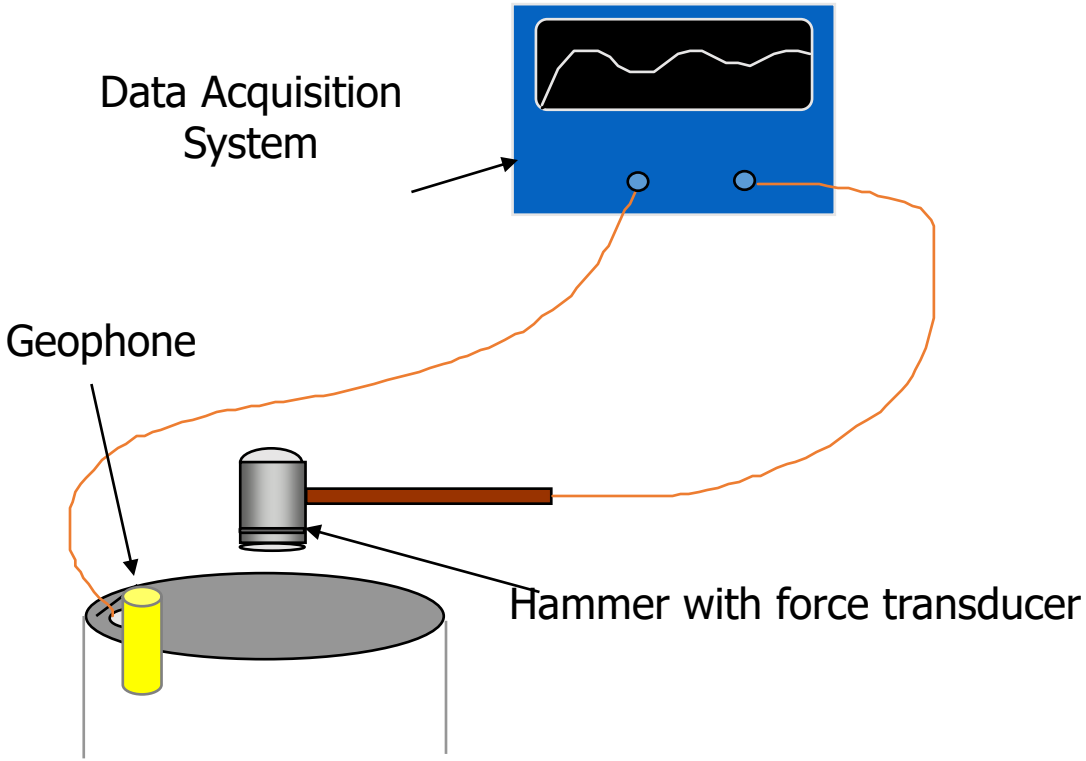
## Impulse-Echo Data Amplification



# Panel Discussion: Horses for Courses – NDT

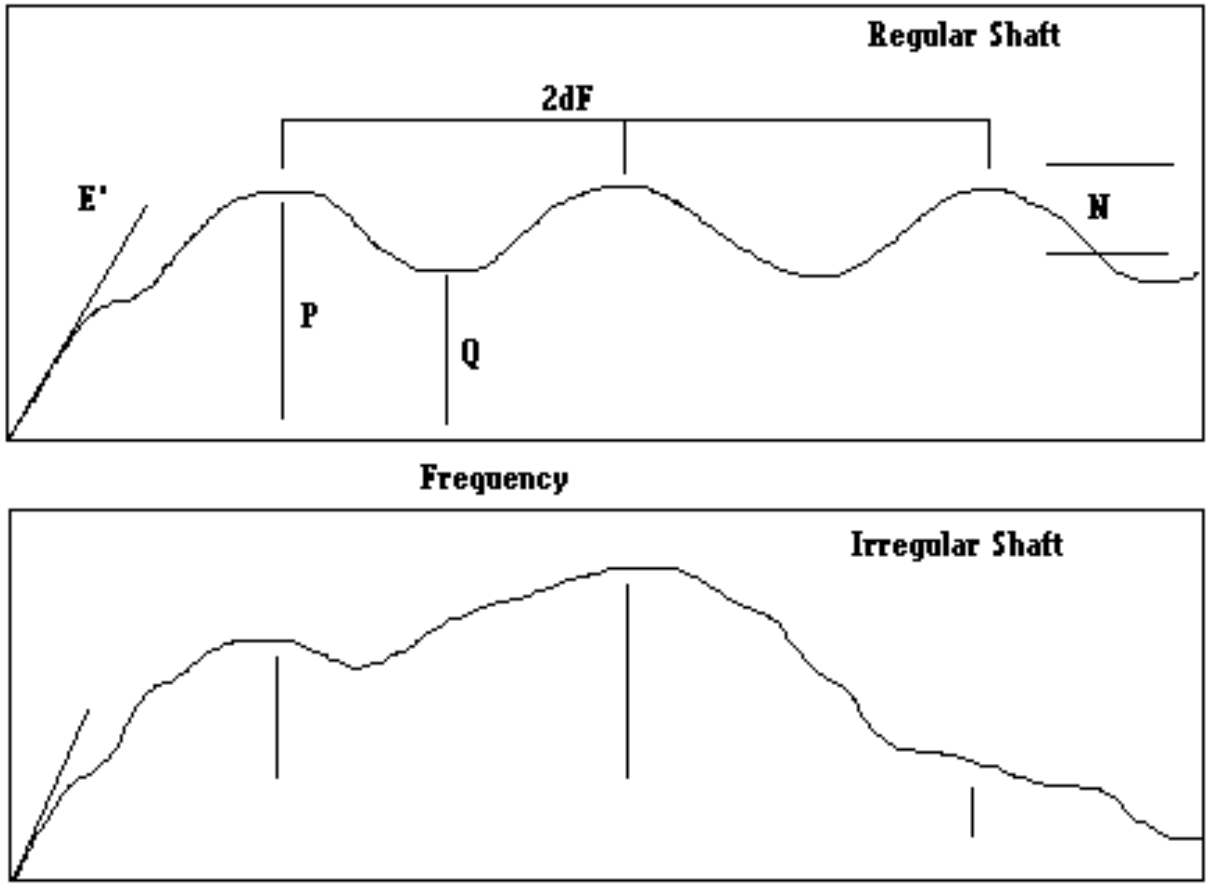
## Impulse Response Spectrum Method - Also ASTM D5882

- Measures stiffness, length, cross-section and concrete quality
- Sensitive to condition of shaft head
- Sensitive to surrounding soils
- Not good with multiple reflectors
- Limited penetration depth



# Panel Discussion: Horses for Courses – NDT

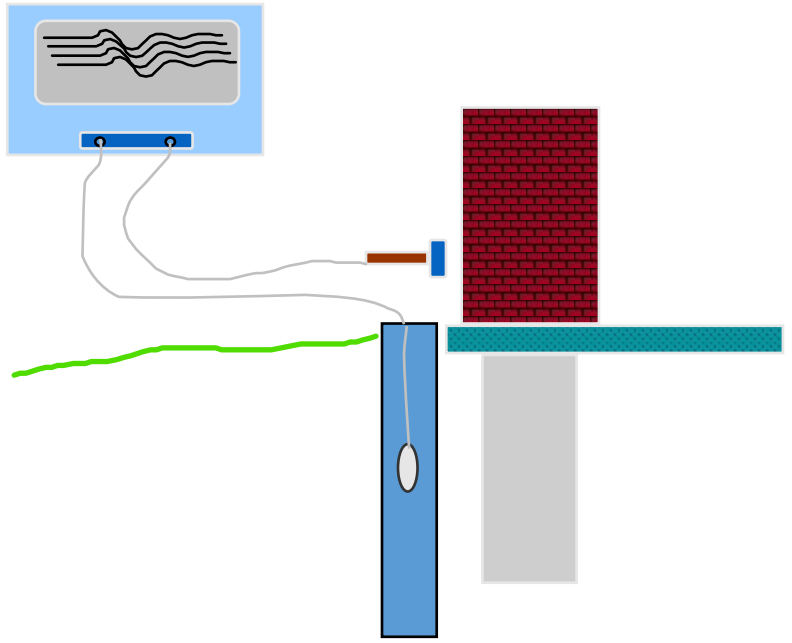
Impulse Response Spectrum Data



# Panel Discussion: Horses for Courses – NDT

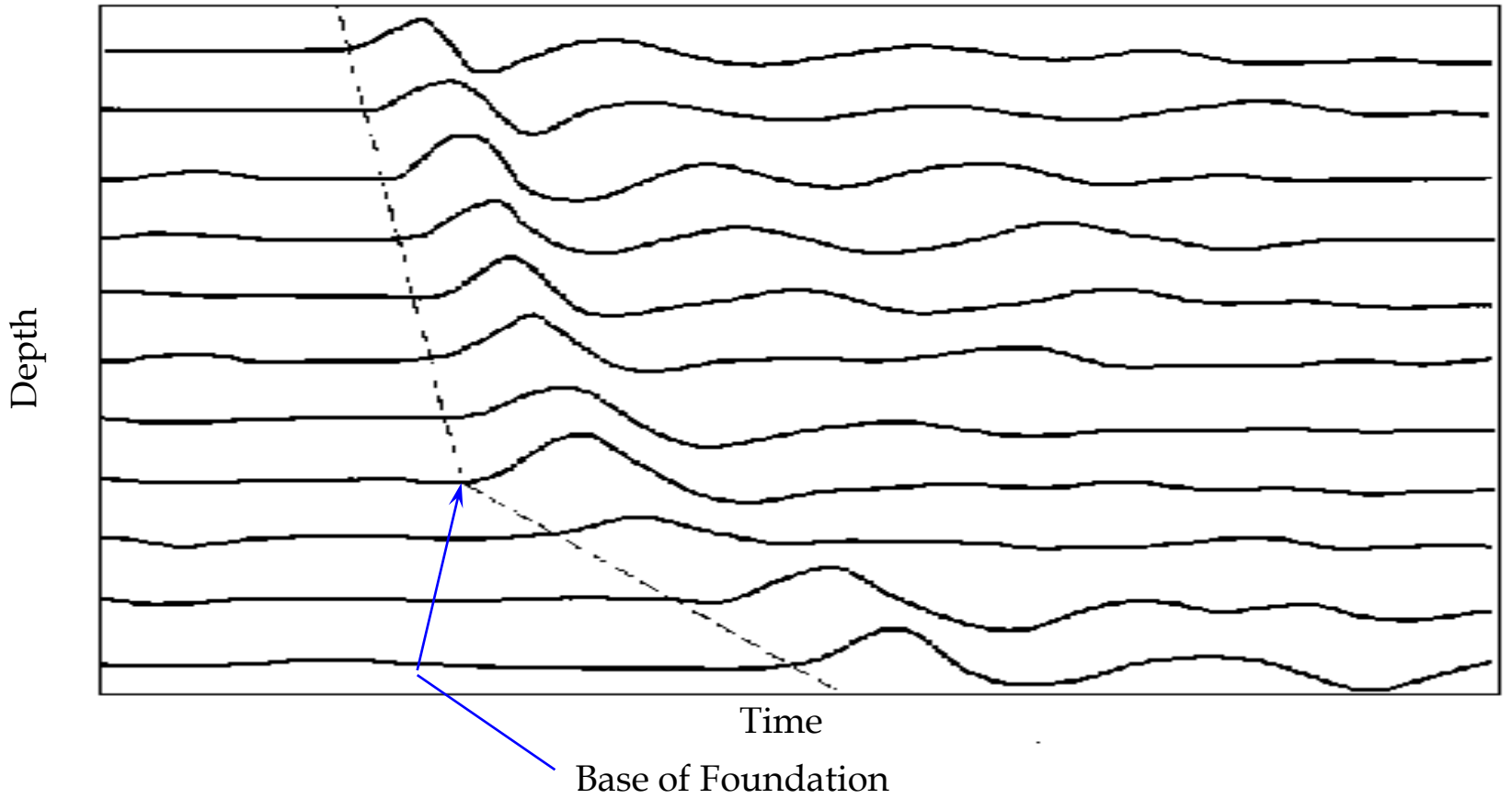
Parallel Seismic Method

- Measures length
- Identifies material
- Can be used on existing structures
- Needs access tube beside structure
- Slower than IE or IR
- Considered to be very reliable



# Panel Discussion: Horses for Courses – NDT

## Parallel Seismic Test Data



# Panel Discussion: Horses for Courses




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**Thank you!**

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