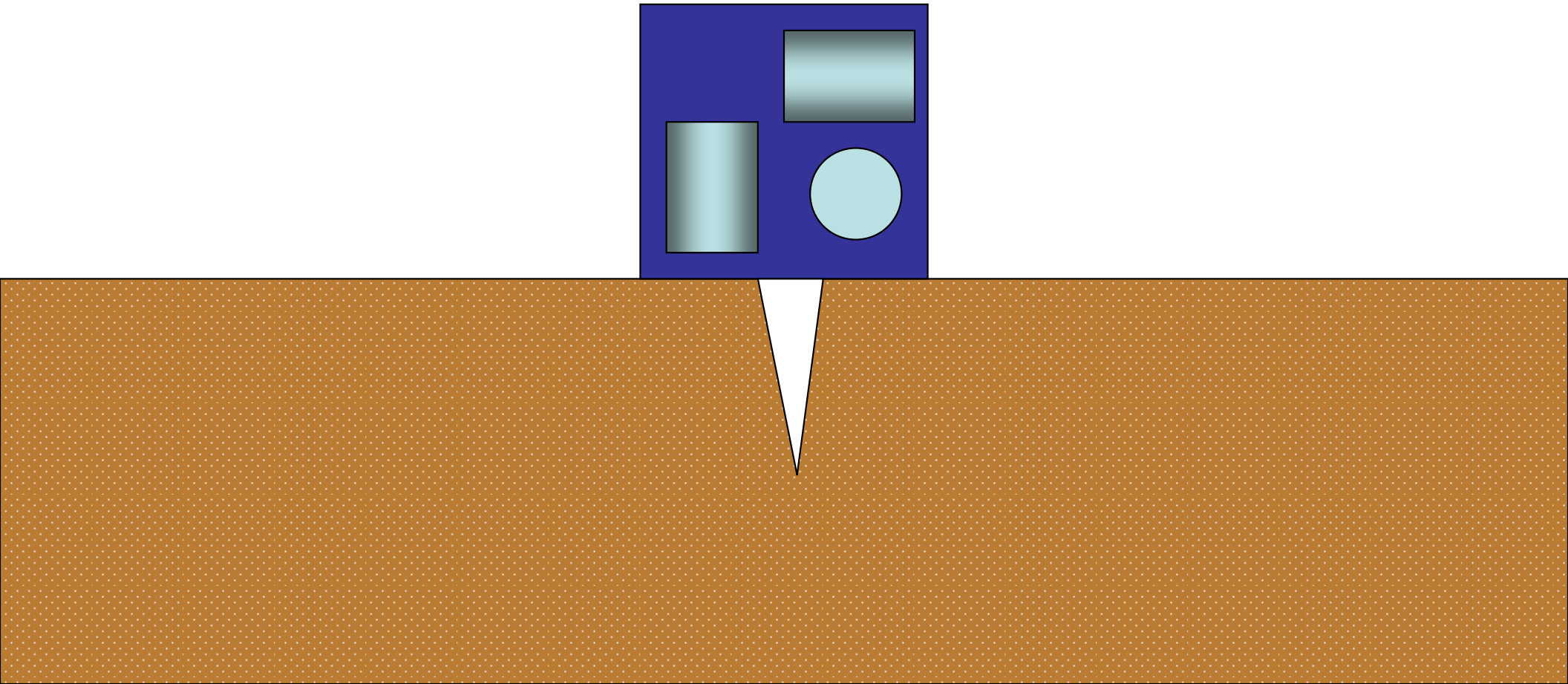
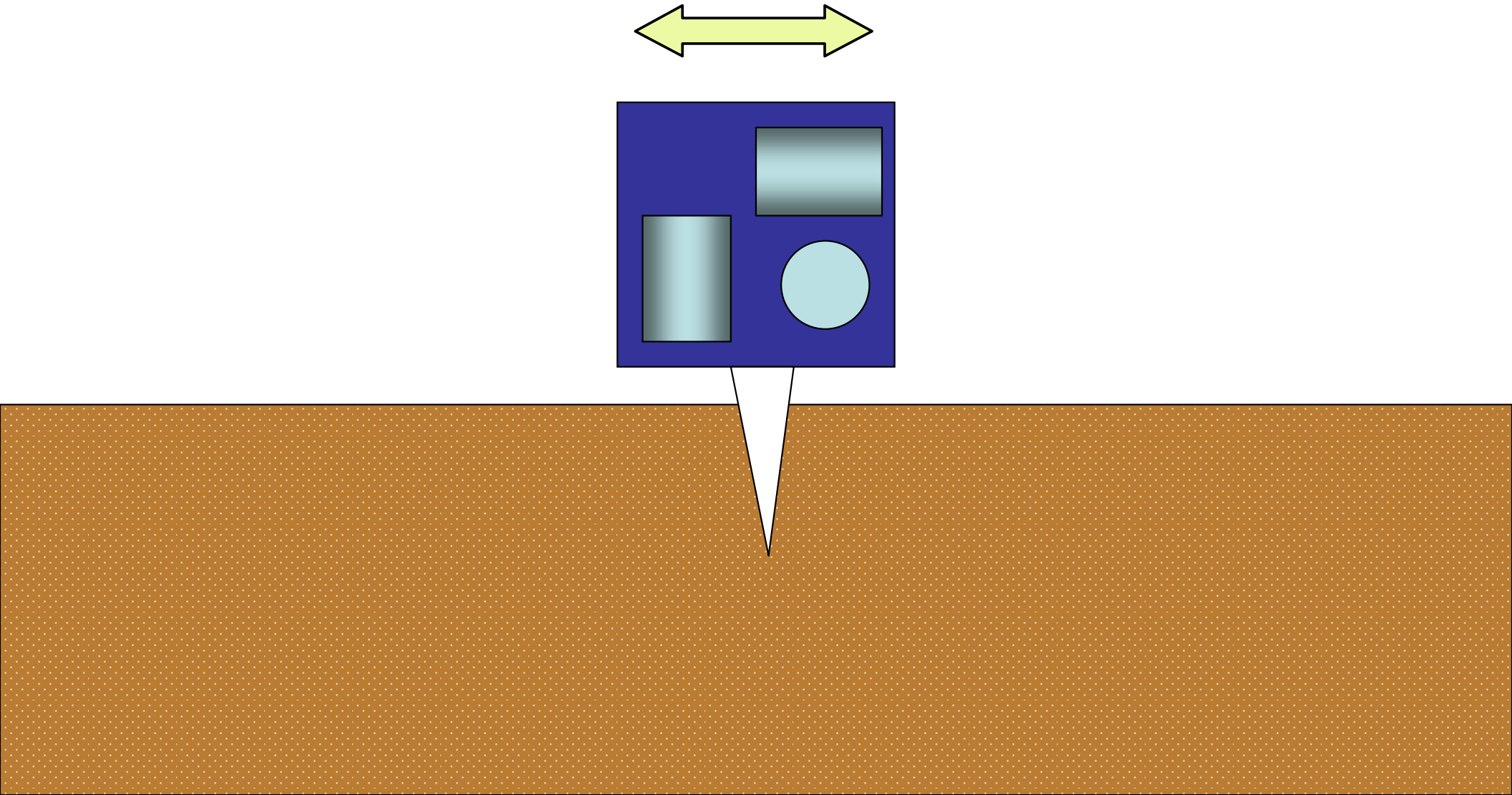
Testing the quality of geophone plants for 3-C land acquisition

Henry C. Bland, Malcolm B. Bertram, Eric V. Gallant

Conventional surface-mount case



Elevated plants cause cases to sway from side-to-side

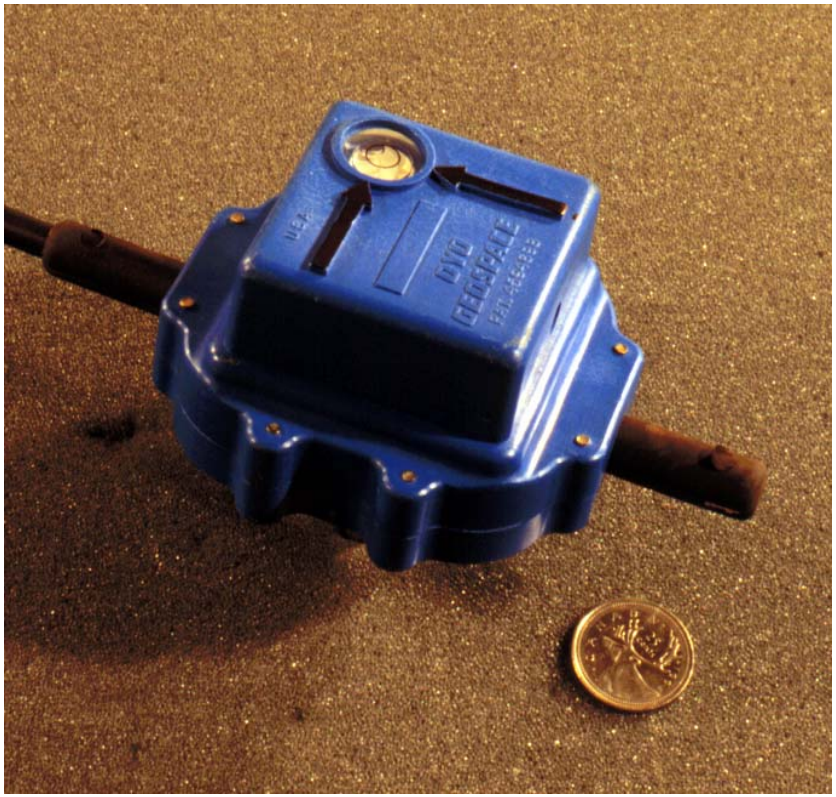


Resonant frequencies for vertical geophones in different soils

Location	*Resonant frequency Hz*
West Texas	400
Friendswood clay	432
Friendswood topsoil	222
EPR grounds	305
Plowed Houston garden	110
Houston lawn near garden	275

C.E. Krohn, 1984, Geophone Ground Coupling: Geophysics

3-C Geophone case styles



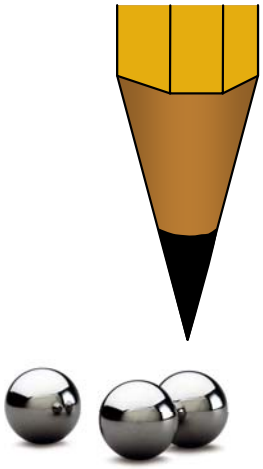
Oyo Geospace
PC-3D

Oyo Geospace
Seismic Nail

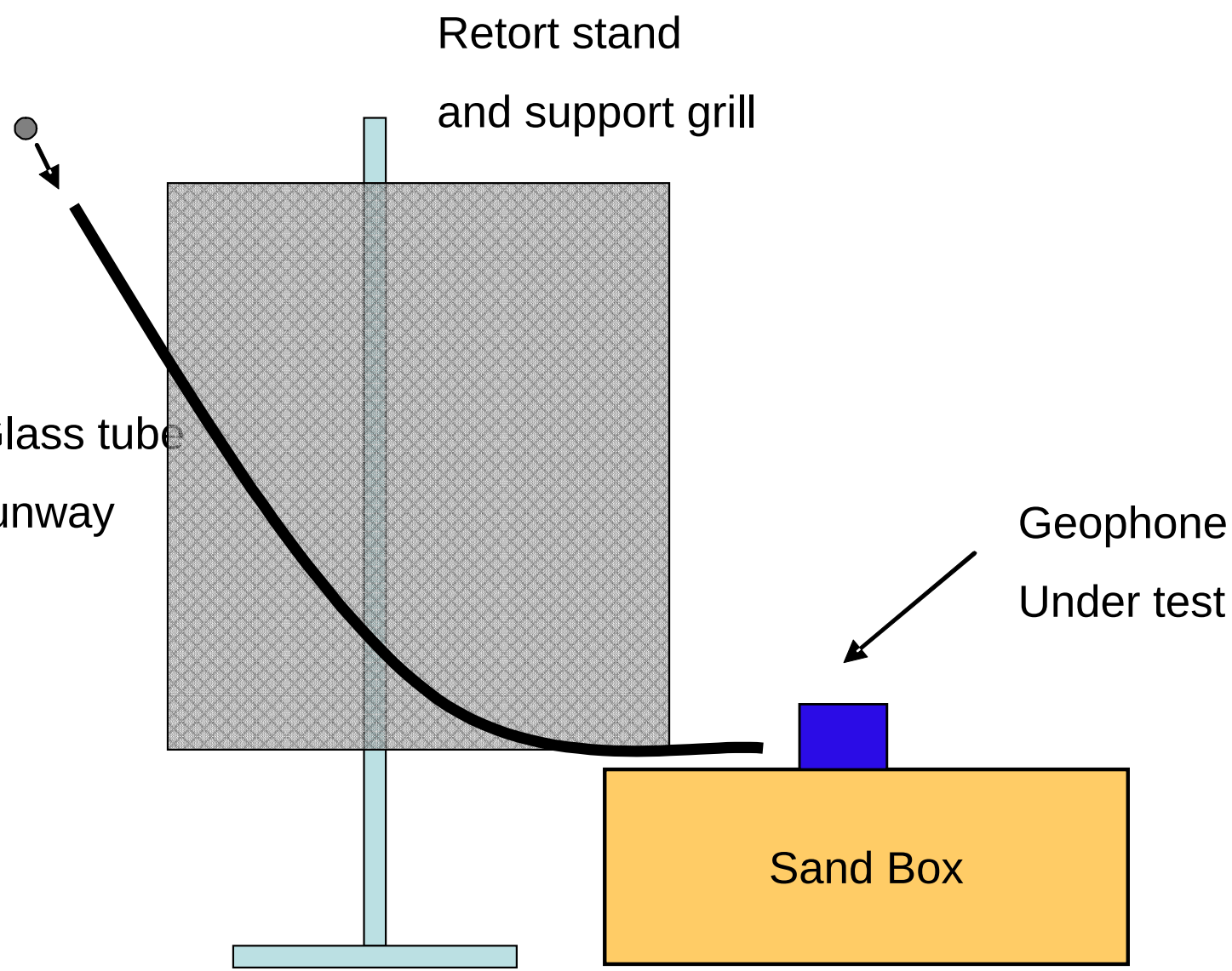
I/O Vectorseis

How does geophone plant-depth affect geophone sway?

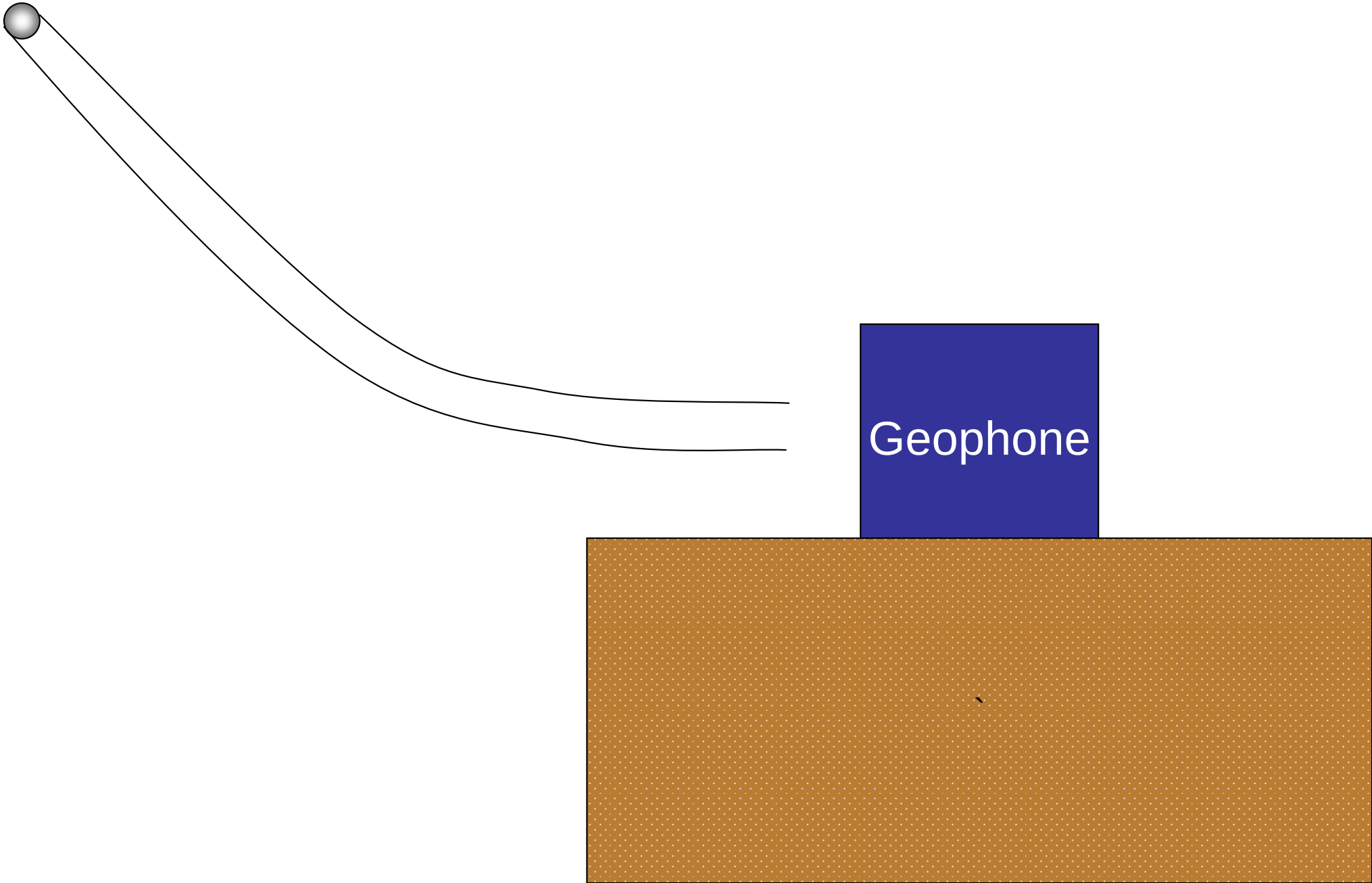
Experimental apparatus



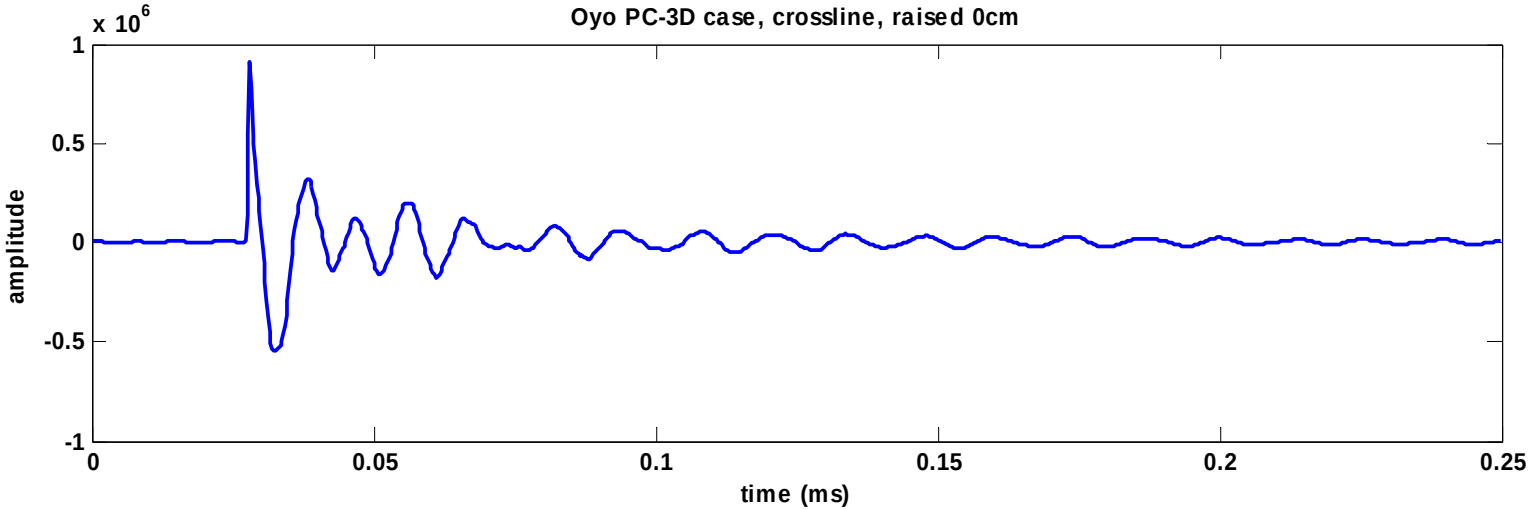
Steel ball 3/16”



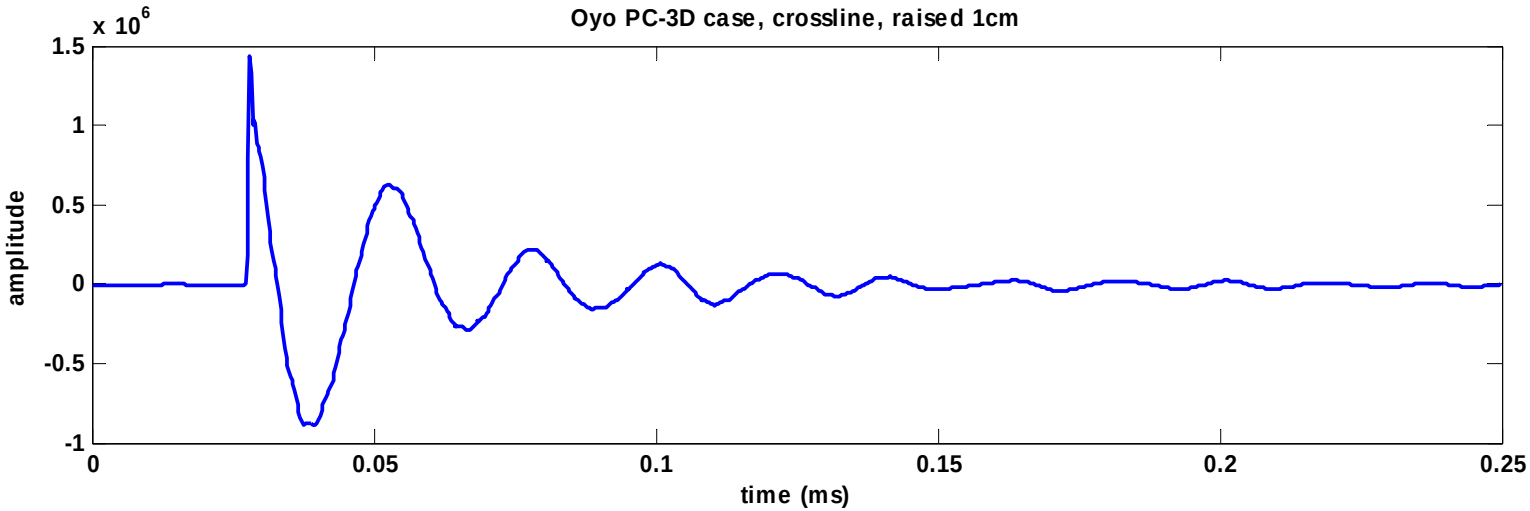
Impulsive Ping



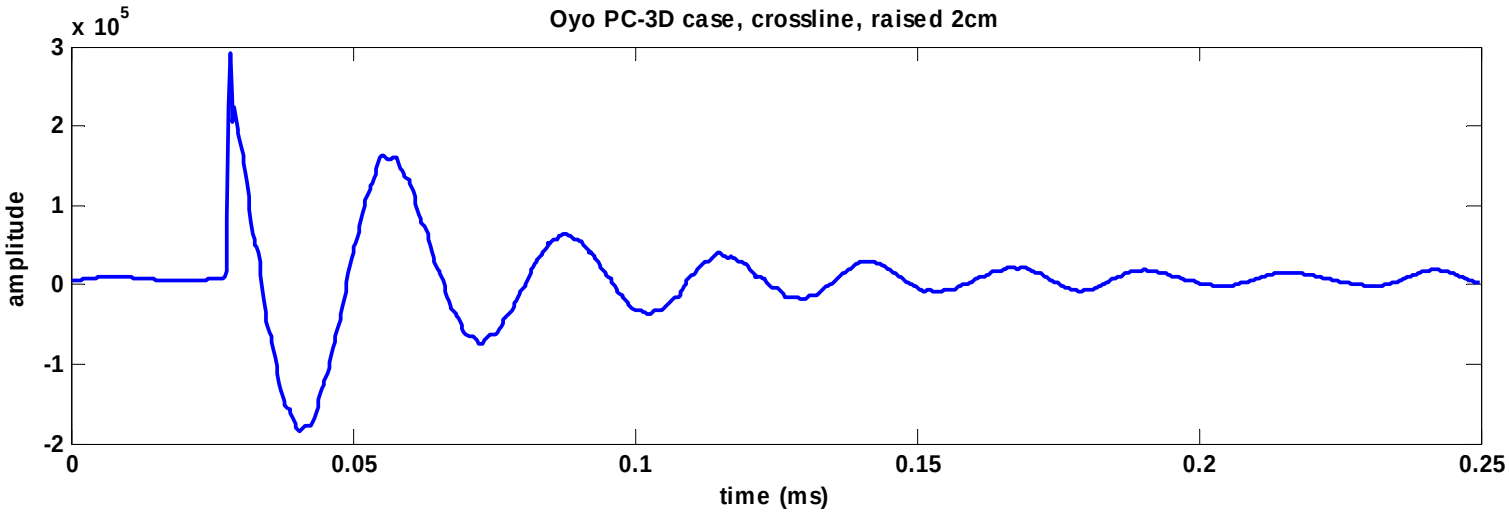
On ground



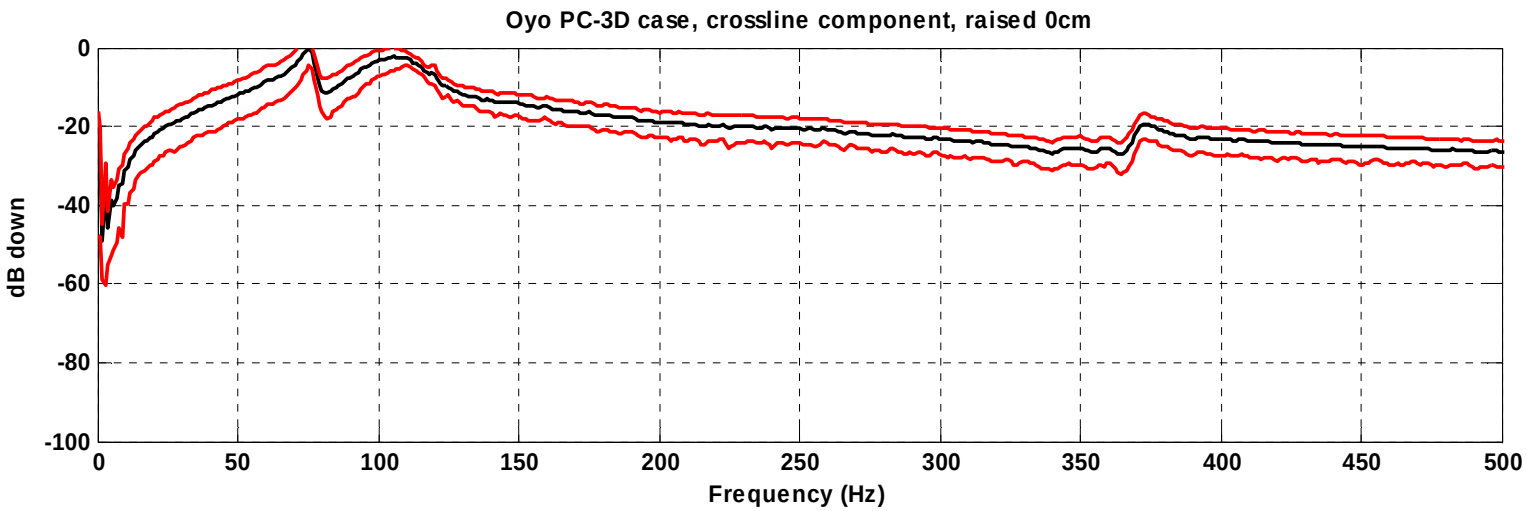
1 cm above ground



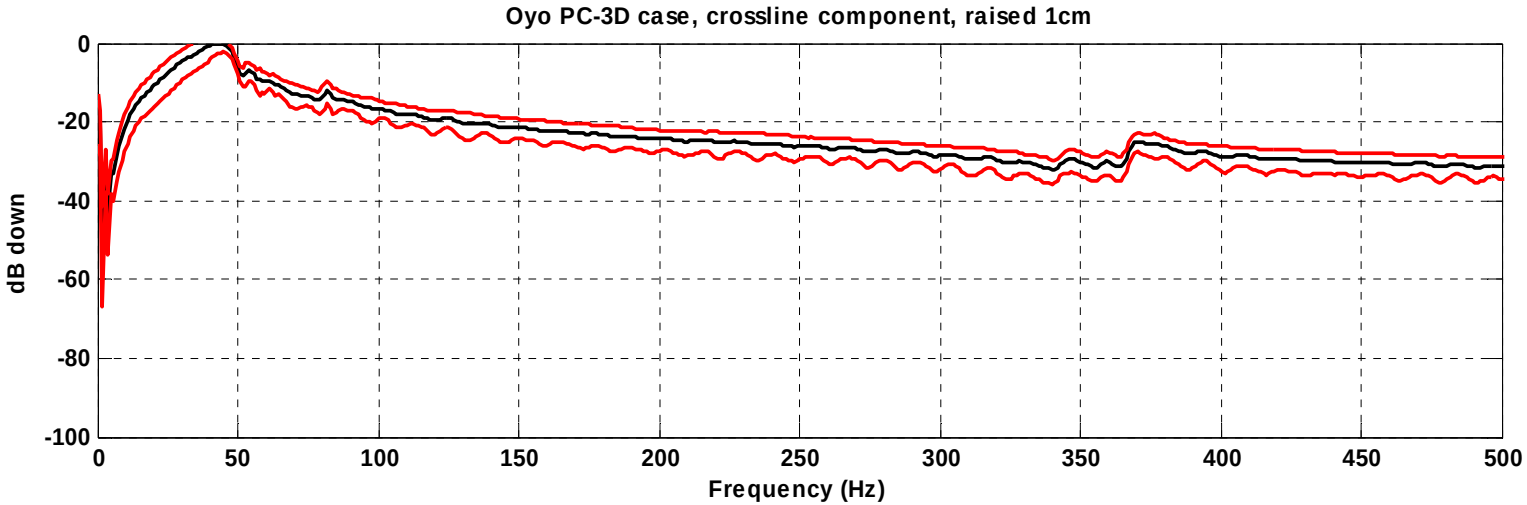
2 cm above ground



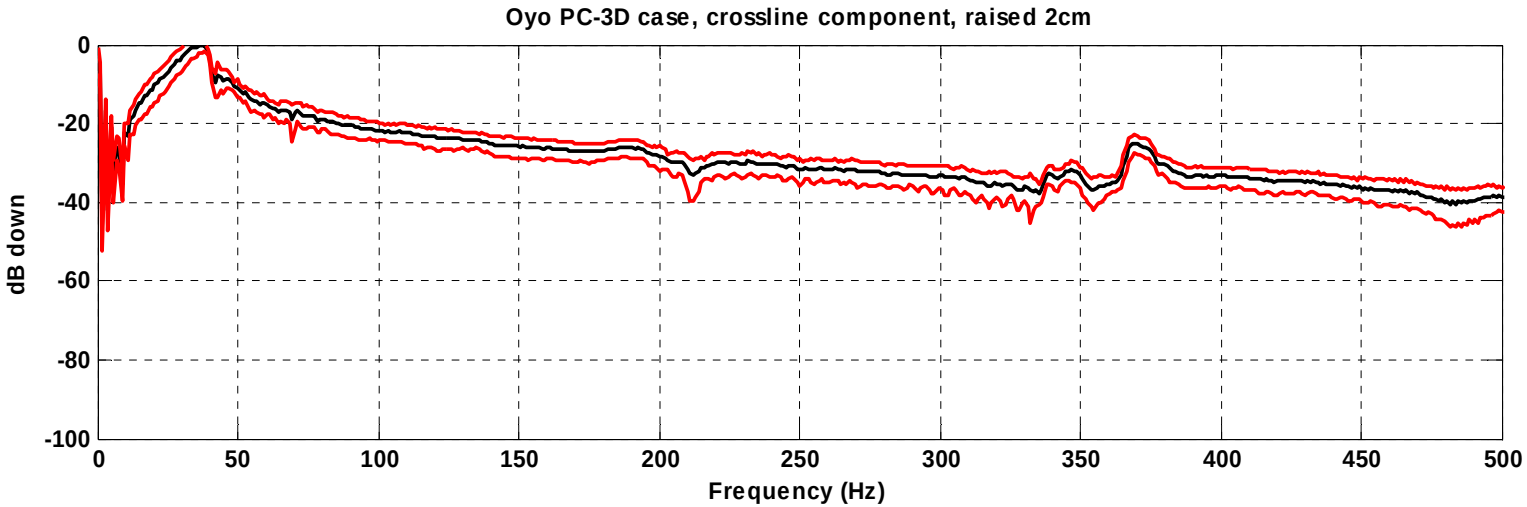
On ground

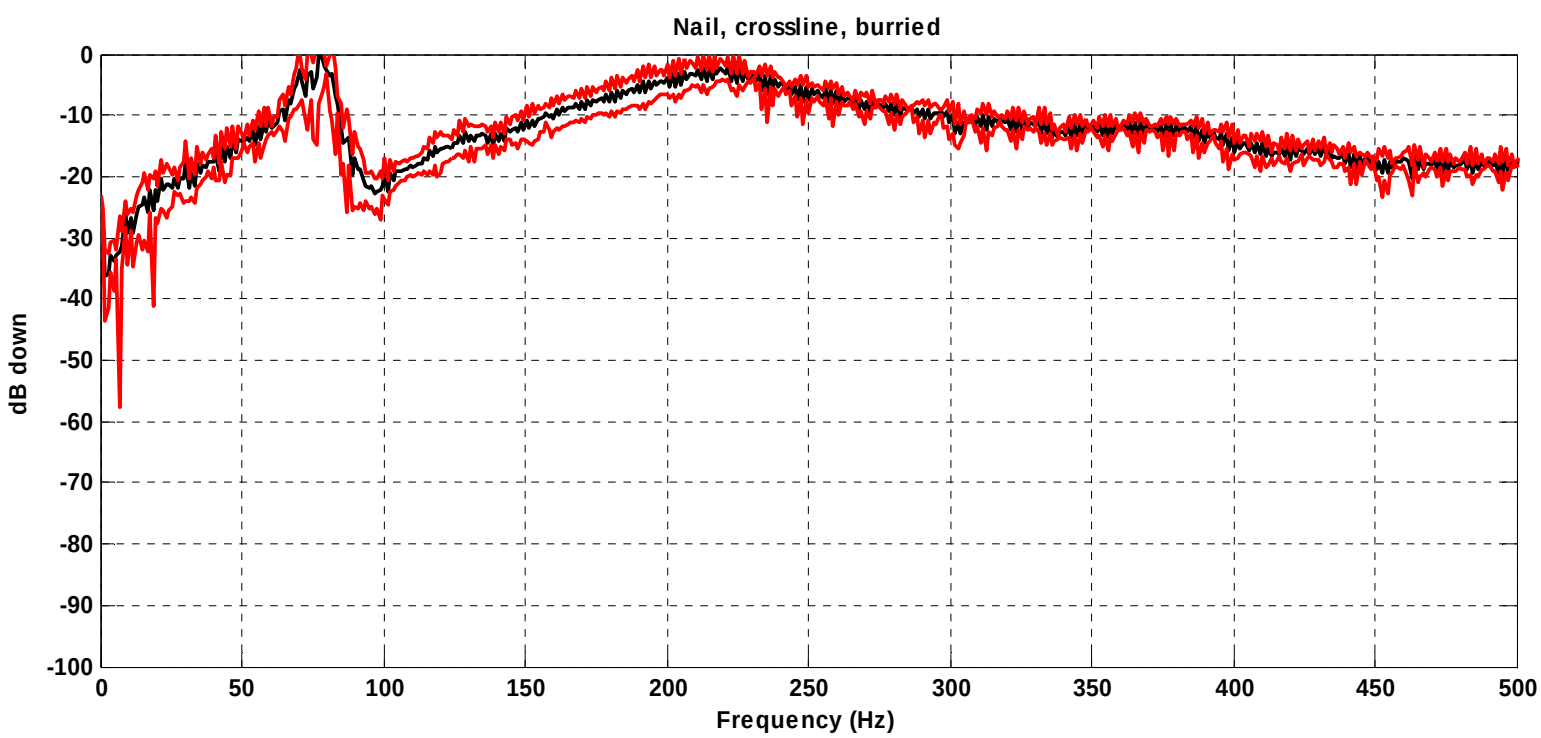


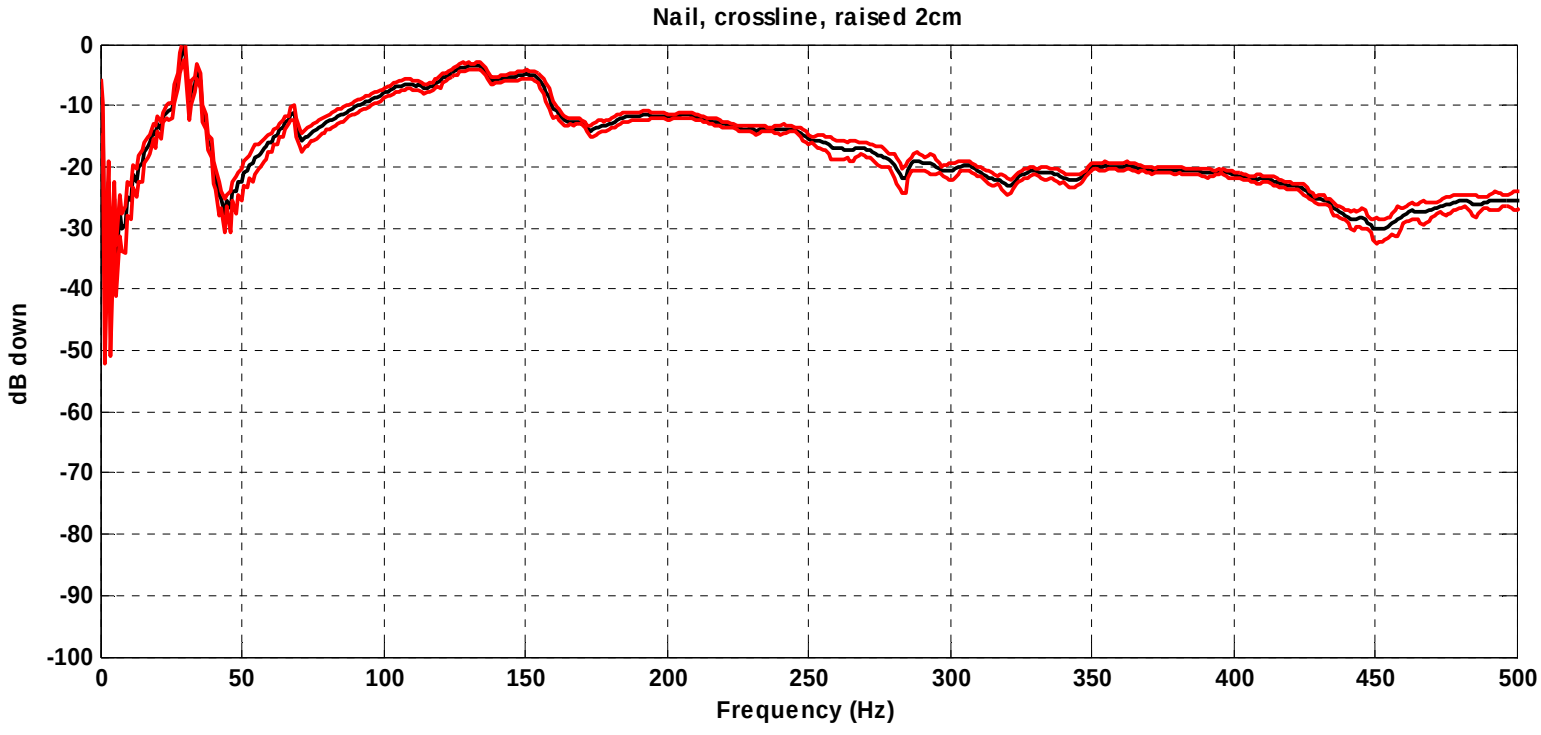
1 cm above ground



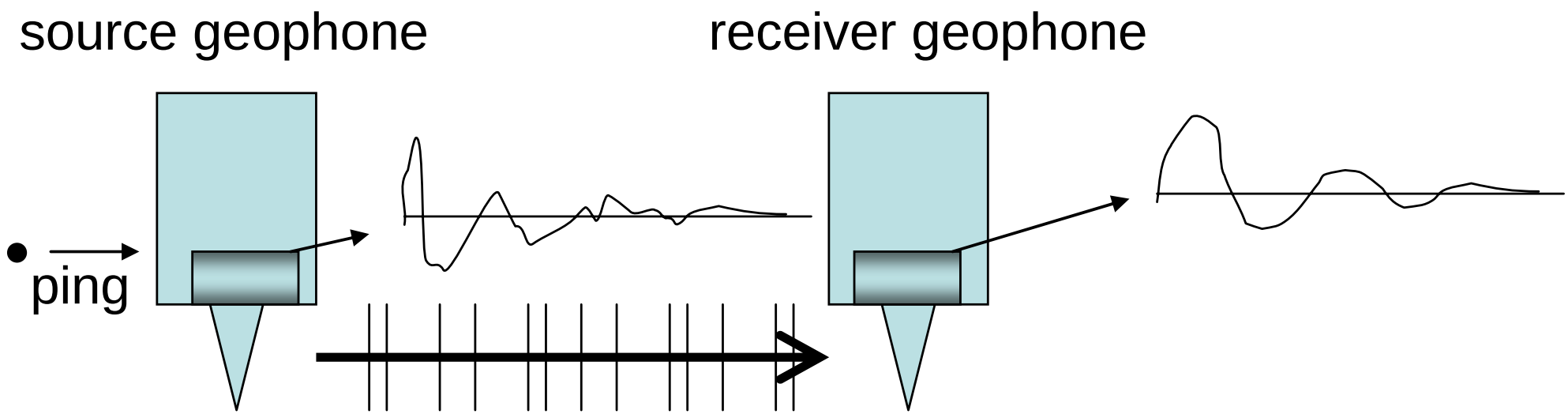
2 cm above ground




Nail, crossline, burried
dB down
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0
50
100
150
200
250
300
350
400
450
500
Frequency (Hz)


Nail, crossline, raised 2cm
dB down
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0
50
100
150
200
250
300
350
400
450
500
Frequency (Hz)

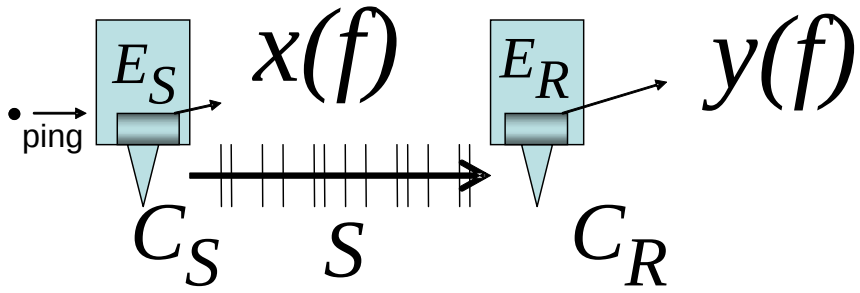
Transmission test



Geophone coupling transfer function

Source geophone

Receiver geophone



$$x(f) = E_s(f)$$

$$y(f) = (C_S\, S\, C_R\, E_R)(f)$$

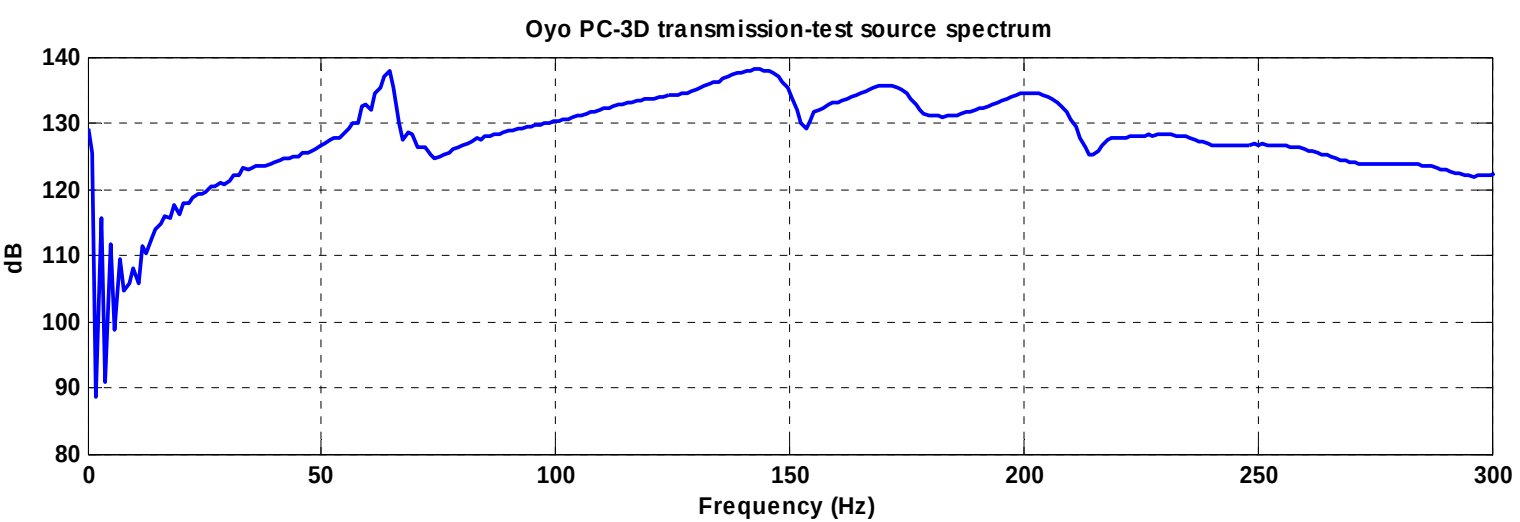
$$E_S = E_R$$

$$C = C_S = C_R$$

$$\frac{y(f)}{x(f)} = (S\,C^2)(f)$$

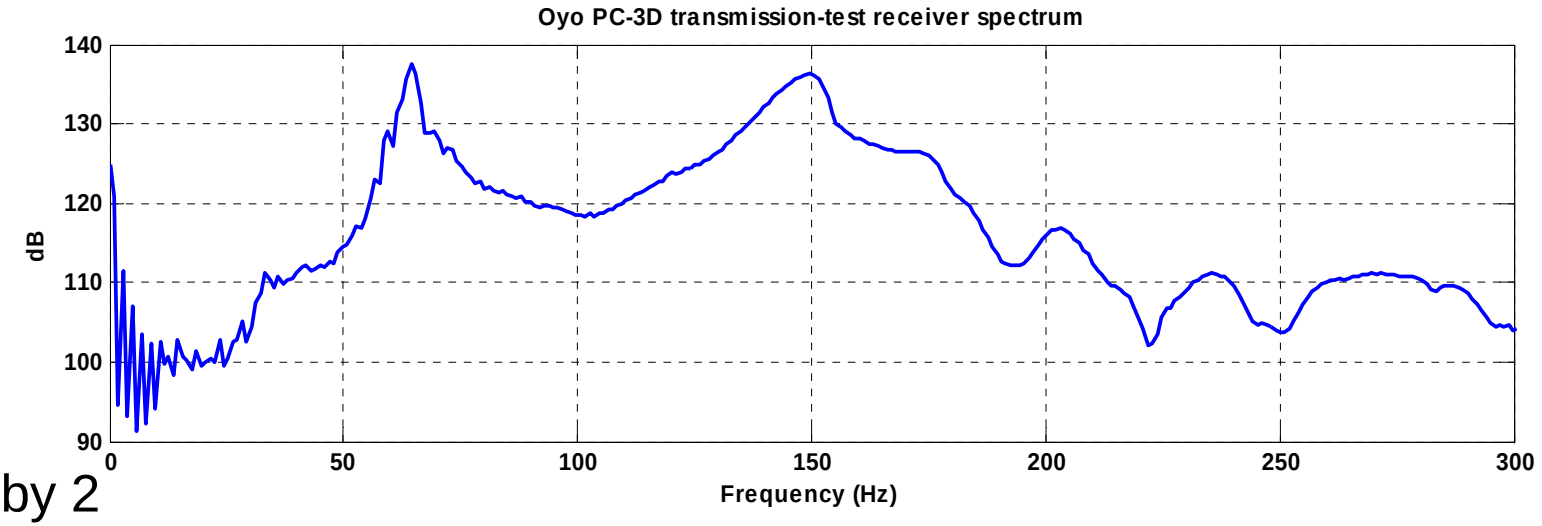
$$|C| = k\sqrt{\frac{|y(f)|}{|x(f)|}}$$

y(f)



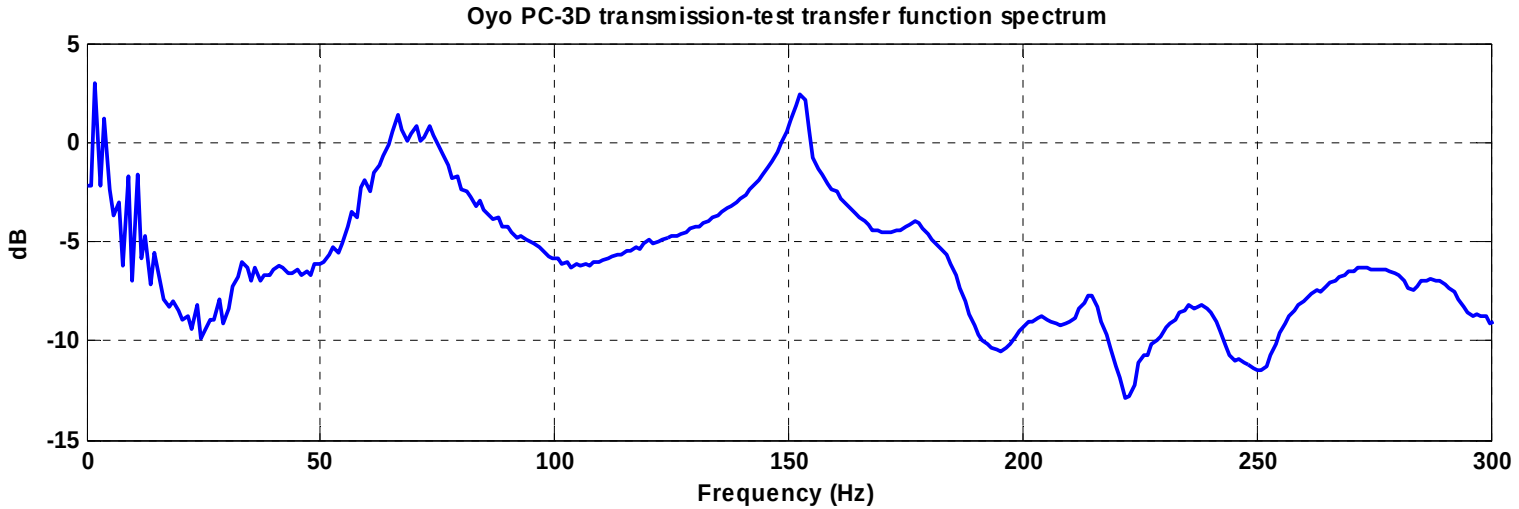
minus

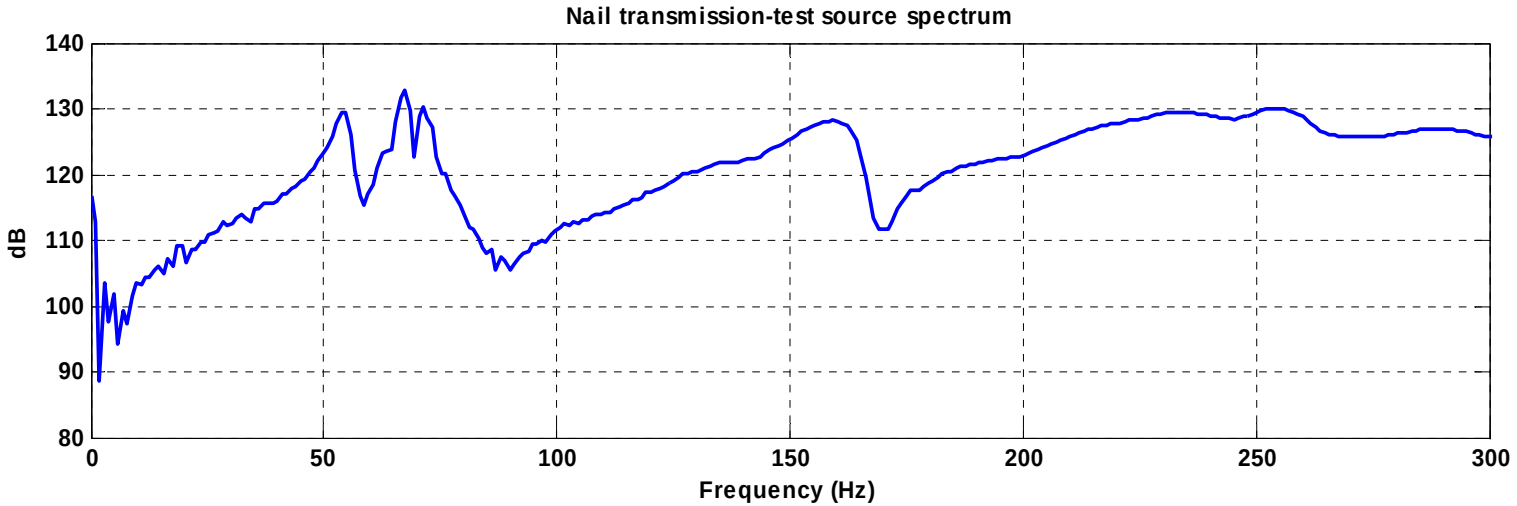
x(f)

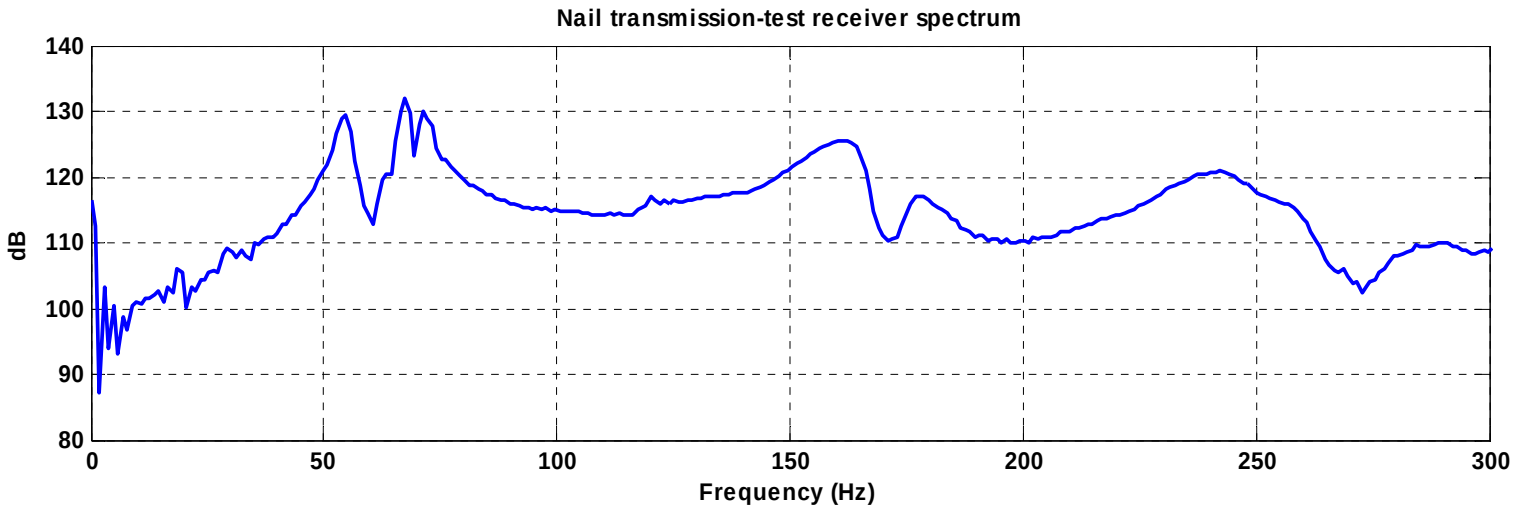


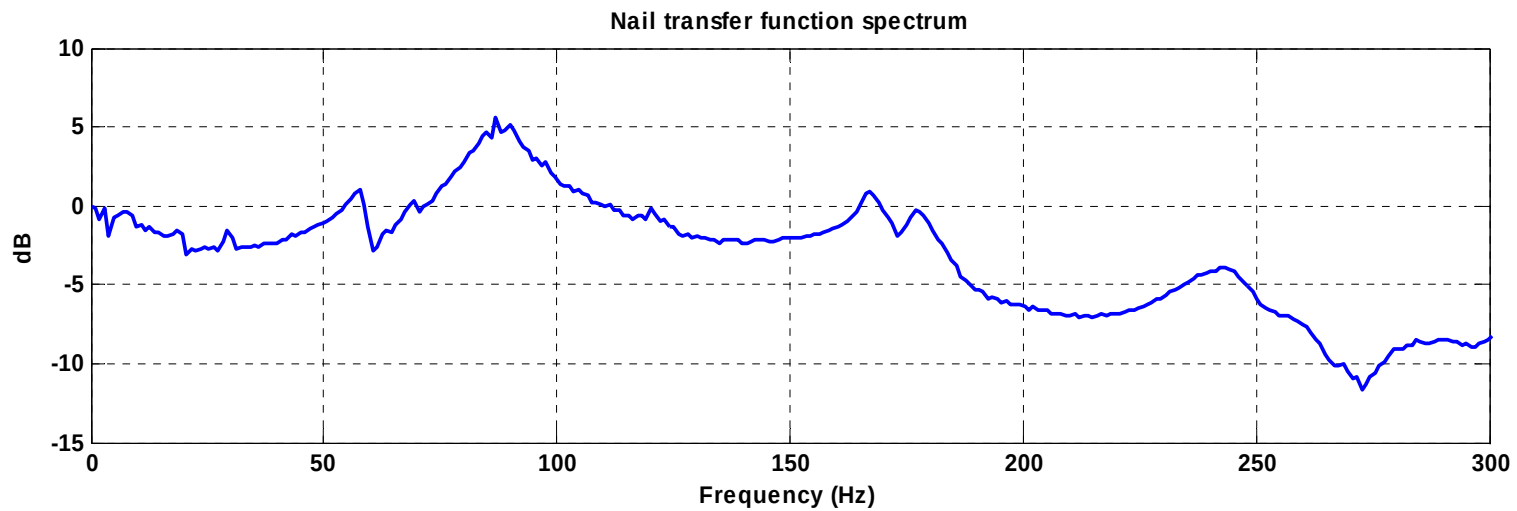
Divide by 2

equals




Nail transmission-test source spectrum
140
130
120
110
100
90
80
dB
0
50
100
150
200
250
300
Frequency (Hz)


Nail transmission-test receiver spectrum
140
130
120
110
100
90
80
dB
0
50
100
150
200
250
300
Frequency (Hz)


Nail transfer function spectrum
10
5
0
-5
-10
-15
dB
0
50
100
150
200
250
300
Frequency (Hz)

Conclusions

- Geophones must be completely planted loose soils for 3-C
- Elevated plants resonate in the data band
- Ping technique useful for finding geophone/ground resonances
- Possible method for measuring coupling?

Acknowledgements

- Oyo Geospace Canada
- CREWES Sponsors