

Development of  
Amplification Factors  
(5% Damped Response Spectra)  
For NEHRP Categories  
in CENA

Bob Darragh  
Walt Silva

Conference Call on Seismic Site  
Amplification in Central and Eastern  
North America  
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PEER, Berkeley, Ca

# Velocity Profiles

## NEHRP Class Vs(30m) m/s

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A	2032
B	1170
C	560
D	270
E	180

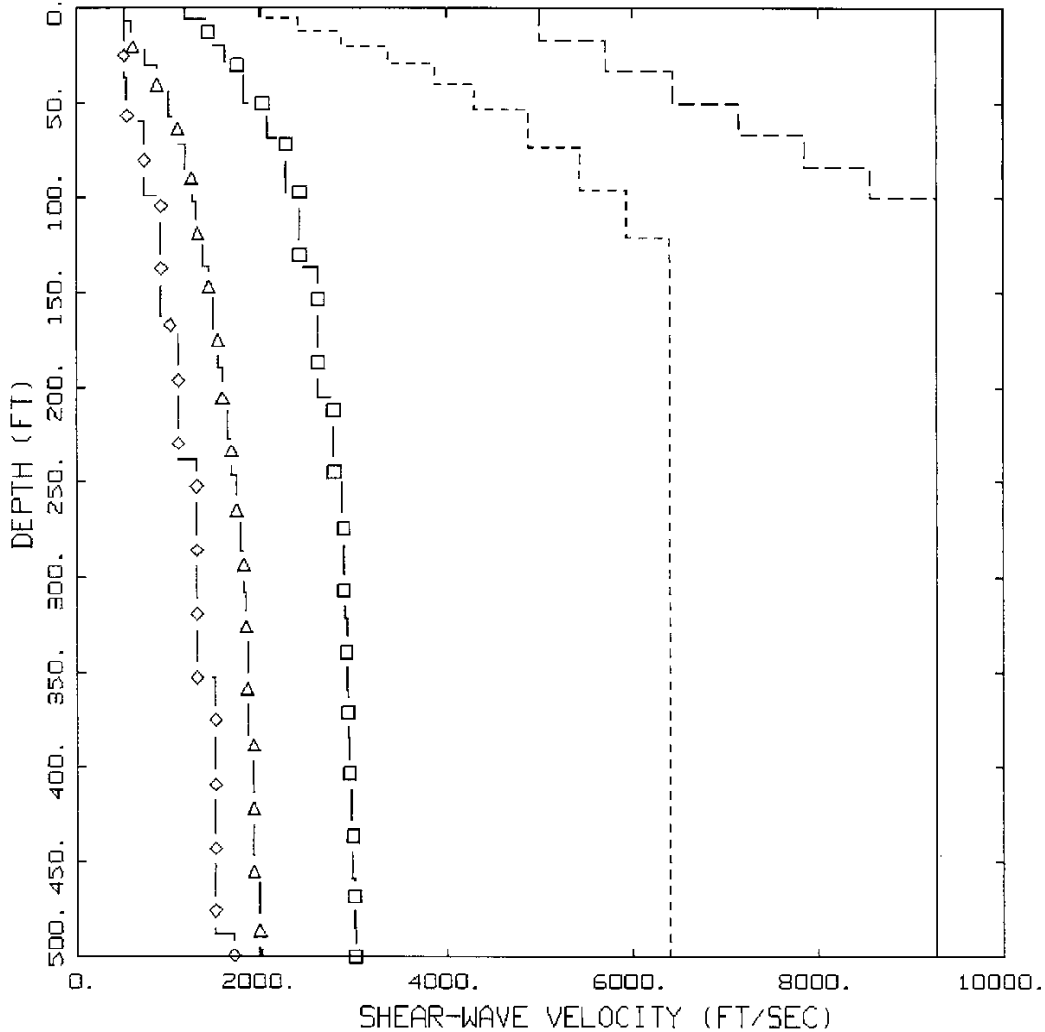
From Kamai et al (2013)

## CENA Hard rock

Thickness (km)	Vs (km/s)	Density (g/cm <sup>3</sup> )
1.0	3.00	2.52
11.0	3.52	2.71
28.0	3.80	2.78
-----	4.68	3.35

Profiles placed on top of CENA crust

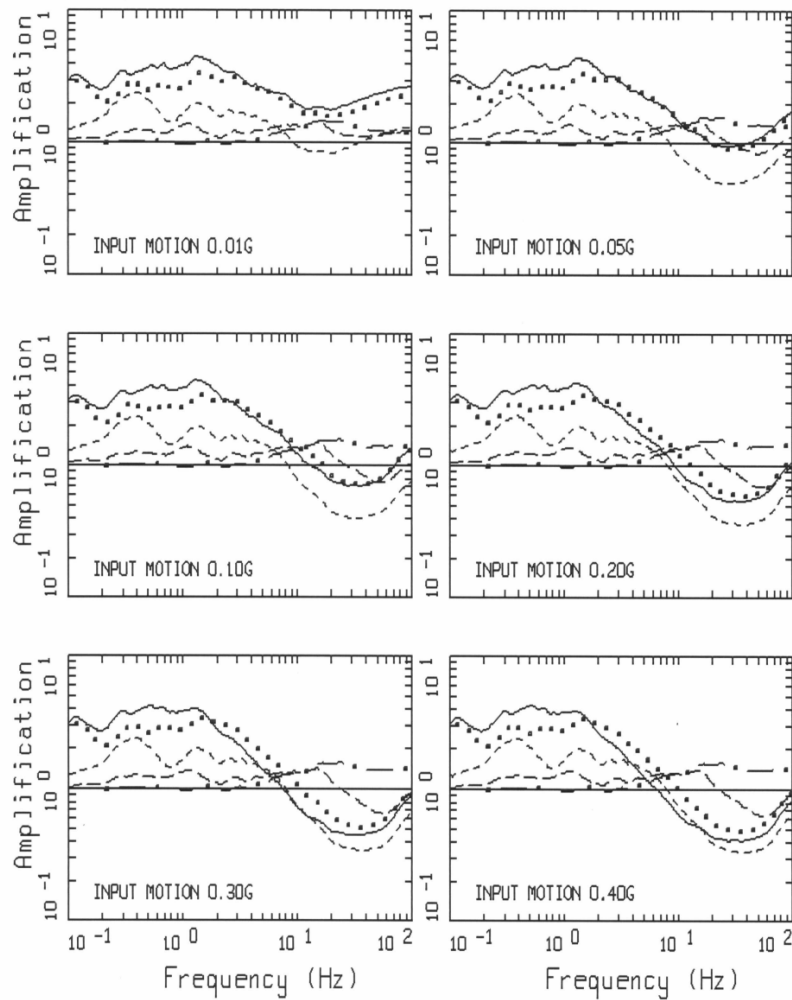
NEHRP category specific shear-wave velocity profiles plotted to 500 feet. NEHRP B profile reaches hard rock at an assumed depth of about 1500 feet, while profiles NEHRP C, D, and E reach hard rock at an assumed depth of about 4000 feet. Depth taken to accommodate lowest frequency of interest (0.1 Hz)



CENA SHEAR WAVE PROFILES

- LEGEND
- 3,000 M/SEC, NEHRP A, HARD ROCK
  - 2,032 M/SEC, NEHRP A
  - 1,170 M/SEC, NEHRP B
  - 560 M/SEC, NEHRP C
  - △— 270 M/SEC, NEHRP D
  - ◇— 180 M/SEC, NEHRP E

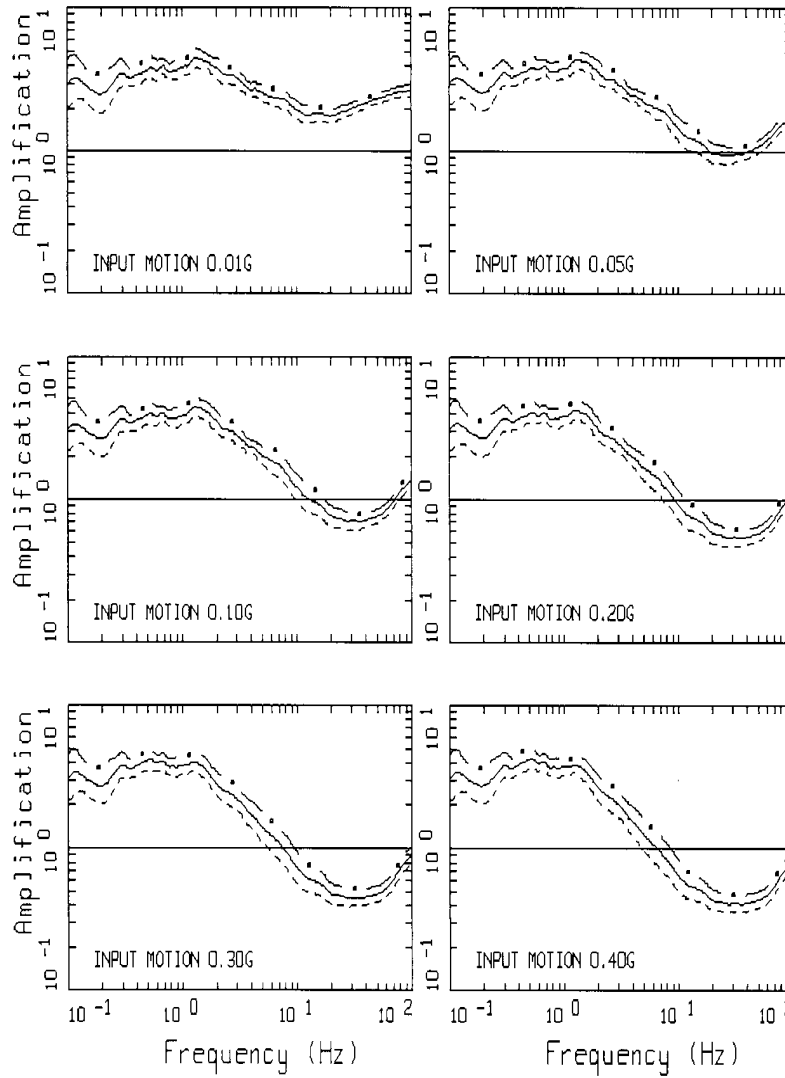
# CENA Amplification Factors for NEHRP Categories



AMPLIFICATION(H), NEHRP BINS OVER 3000 M/S  
 PR CURVES: PAGE 1 OF 2

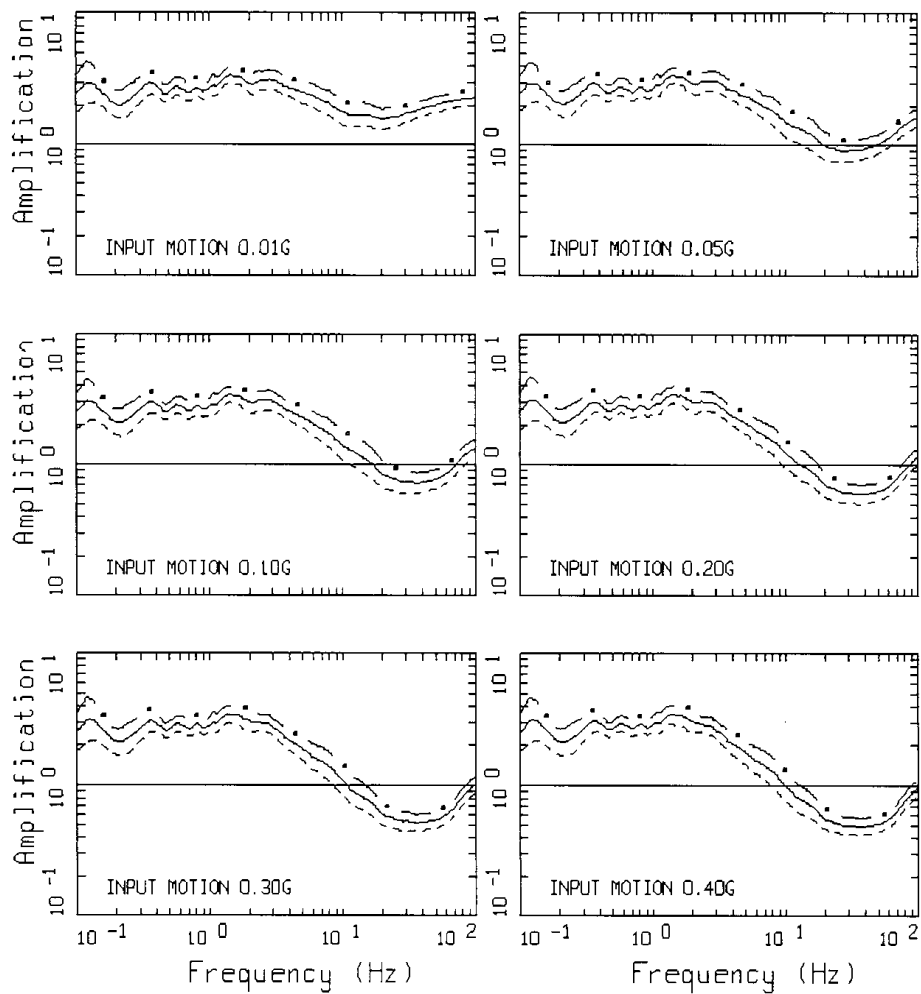
LEGEND

- 180 M/S, NEHRP E: 50TH PERCENTILE
- ..... 270 M/S, NEHRP D: 50TH PERCENTILE
- 560 M/S, NEHRP C: 50TH PERCENTILE
- · - · 1170 M/S, NEHRP B: 50TH PERCENTILE
- - - - 2032 M/S, NEHRP A: 50TH PERCENTILE
- UNITY LINE



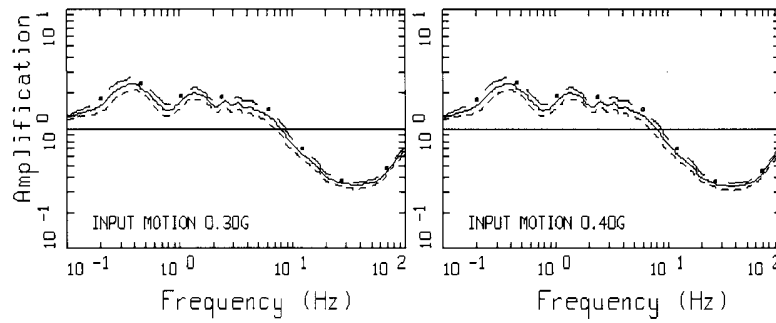
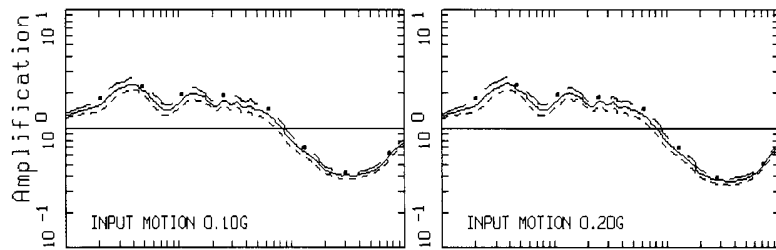
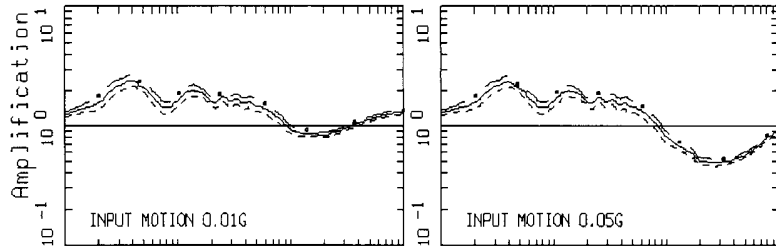
AMPLIFICATION(H), NEHRP E, 180 M/S/3000 M/S, 2000 M  
PR CURVES: PAGE 1 OF 2

LEGEND  
 - · - 84TH PERCENTILE  
 ——— 50TH PERCENTILE  
 - - - - 16TH PERCENTILE  
 ——— UNITY LINE



AMPLIFICATION(H), NEHRP D, 270 M/S/3000 M/S, 2000 M  
 PR CURVES: PAGE 1 OF 2

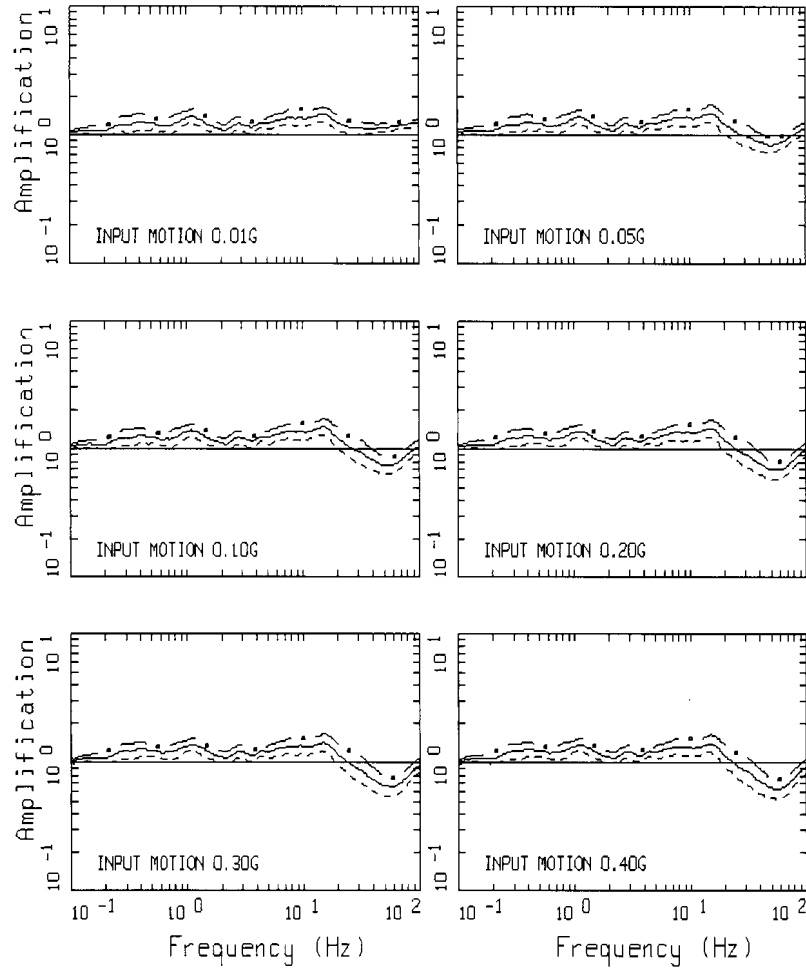
LEGEND  
 - · - 84TH PERCENTILE  
 ——— 50TH PERCENTILE  
 - - - 16TH PERCENTILE  
 ——— UNITY LINE



AMPLIFICATION(H), NEHRP C, 560 M/S/3000 M/S, 1000 M  
 PR CURVES: PAGE 1 OF 2

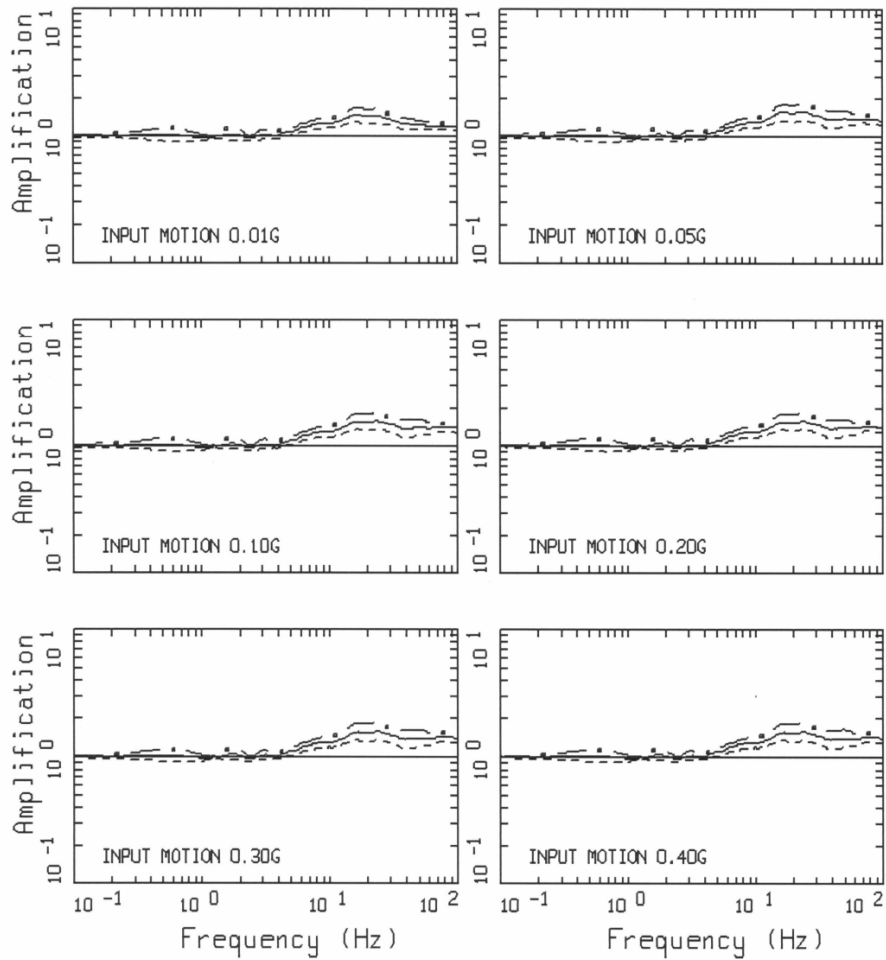
- LEGEND
- . - 84TH PERCENTILE
  - 50TH PERCENTILE
  - - - 16TH PERCENTILE
  - UNITY LINE





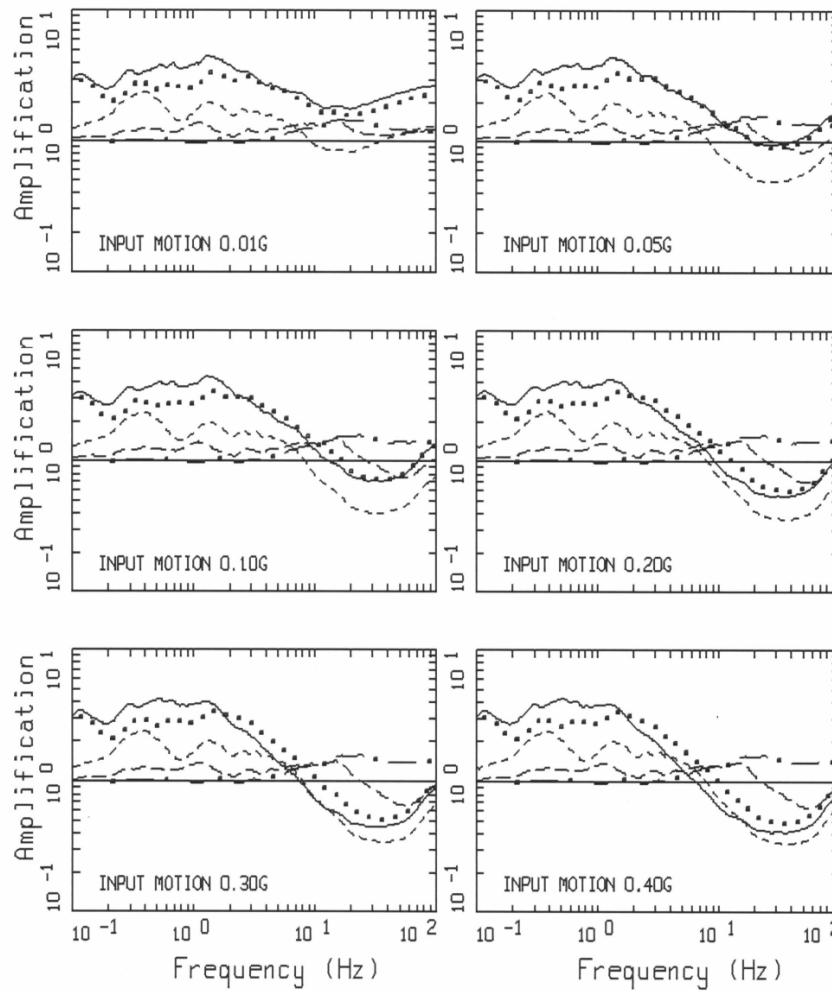
AMPLIFICATION(H), NEHRP B, 1170 M/S/3000 M/S, 500 M  
 PR CURVES: PAGE 1 OF 2

LEGEND  
 - . - . 84TH PERCENTILE  
 ——— 50TH PERCENTILE  
 - - - - 16TH PERCENTILE  
 ——— UNITY LINE



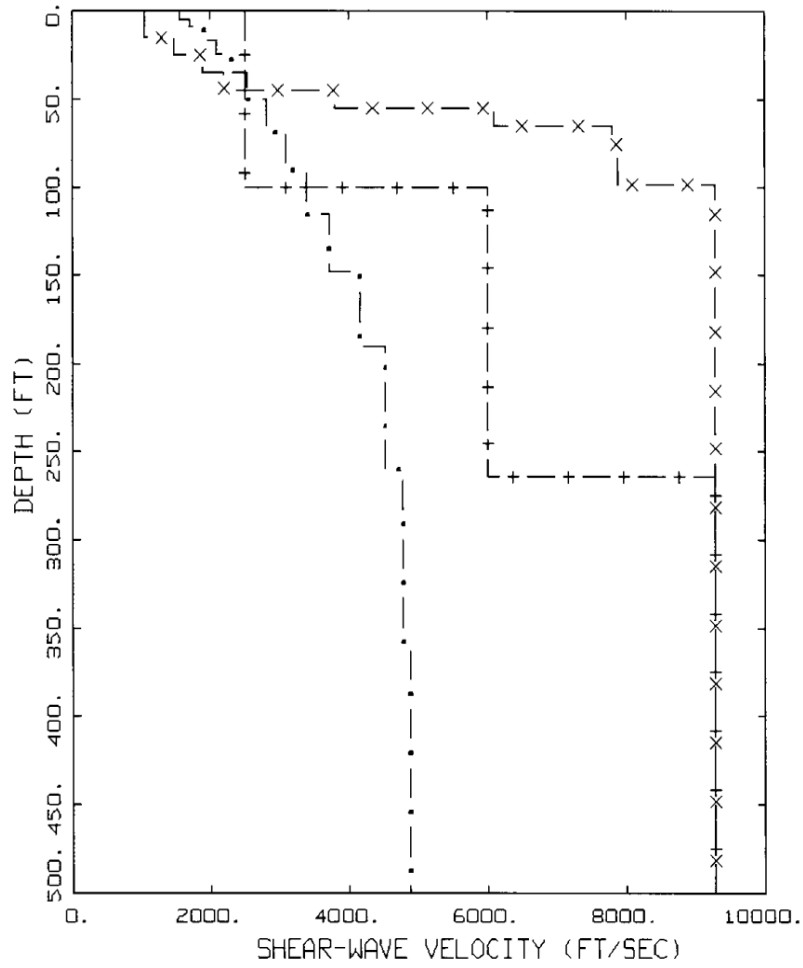
AMPLIFICATION(H), NEHRP A, 2032 M/S/3000 M/S, 50 M  
 PR CURVES: PAGE 1 OF 2

- LEGEND
- 84TH PERCENTILE
  - 50TH PERCENTILE
  - ..... 16TH PERCENTILE
  - UNITY LINE



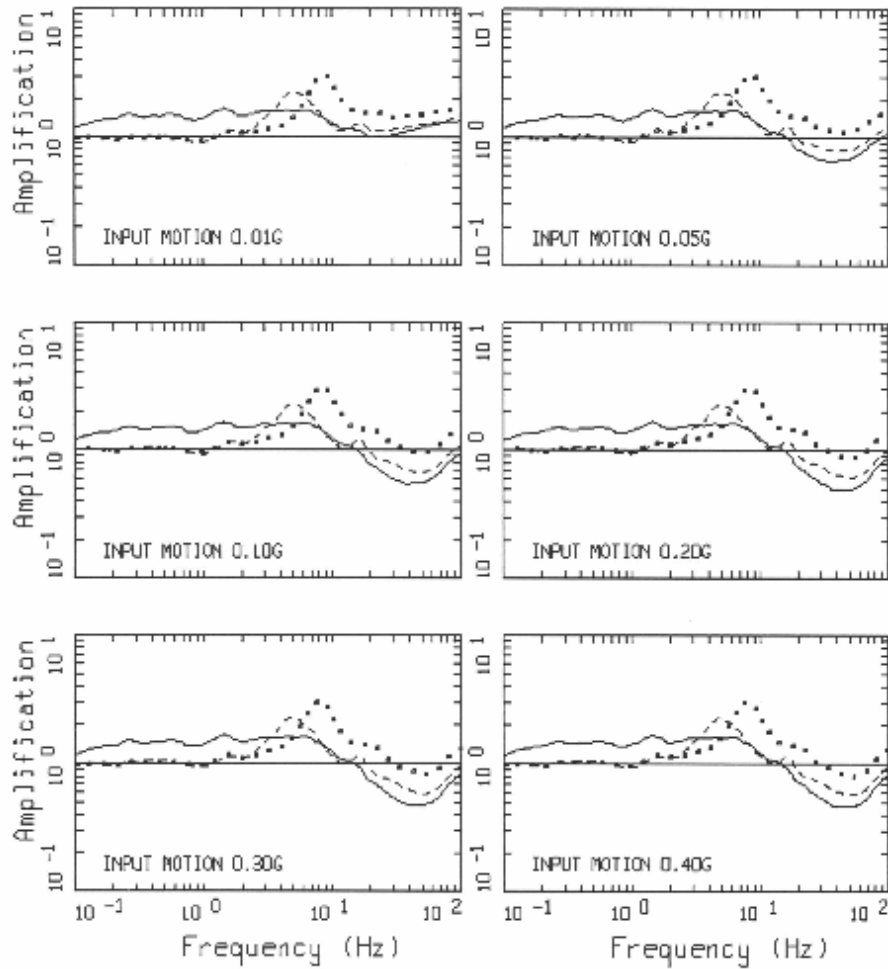
AMPLIFICATION(H), NEHRP BINS OVER 3000 M/S  
 PR CURVES: PAGE 1 OF 2

- LEGEND
- 180 M/S, NEHRP E: 50TH PERCENTILE
  - ..... 270 M/S, NEHRP D: 50TH PERCENTILE
  - 560 M/S, NEHRP C: 50TH PERCENTILE
  - . - . 1170 M/S, NEHRP B: 50TH PERCENTILE
  - - - - 2032 M/S, NEHRP A: 50TH PERCENTILE
  - UNITY LINE



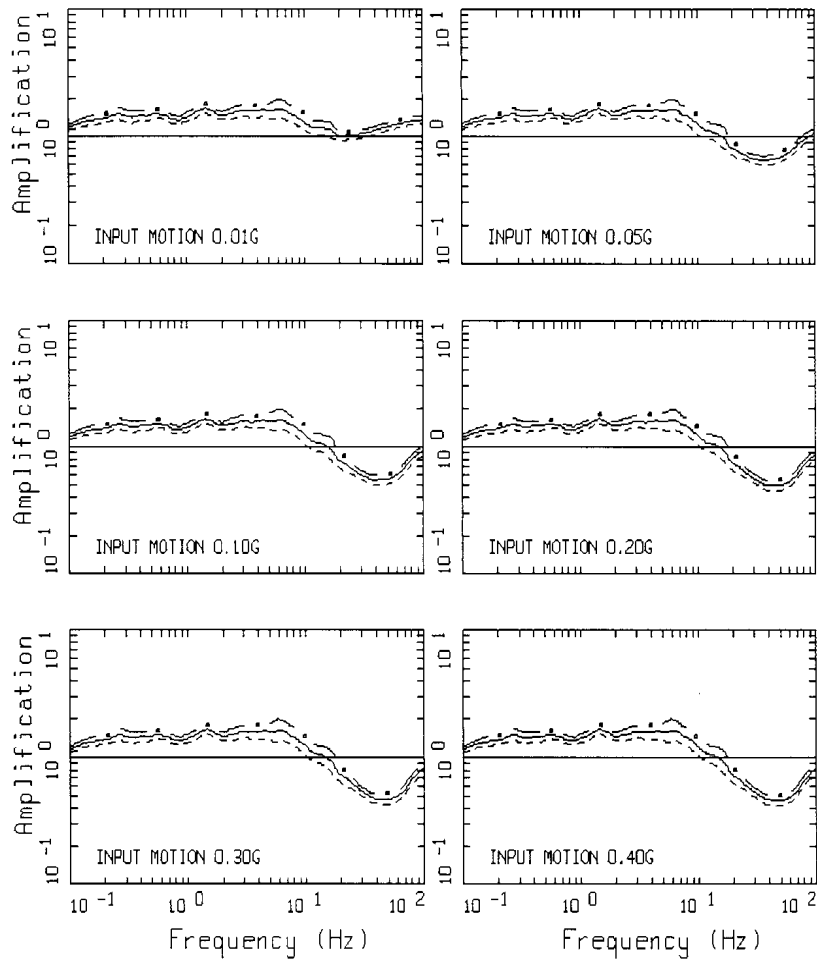
CENA SHEAR WAVE PROFILES  
760 M/S, DIFFERENT GEOLOGY

- LEGEND
- • — 760 M/SEC, NEHRP BC, WEATHERED FIRM ROCK
  - x — 760 M/SEC, NEHRP BC, PIEDMONT, SAPROLITE
  - + — 760 M/SEC, NEHRP BC, TILL



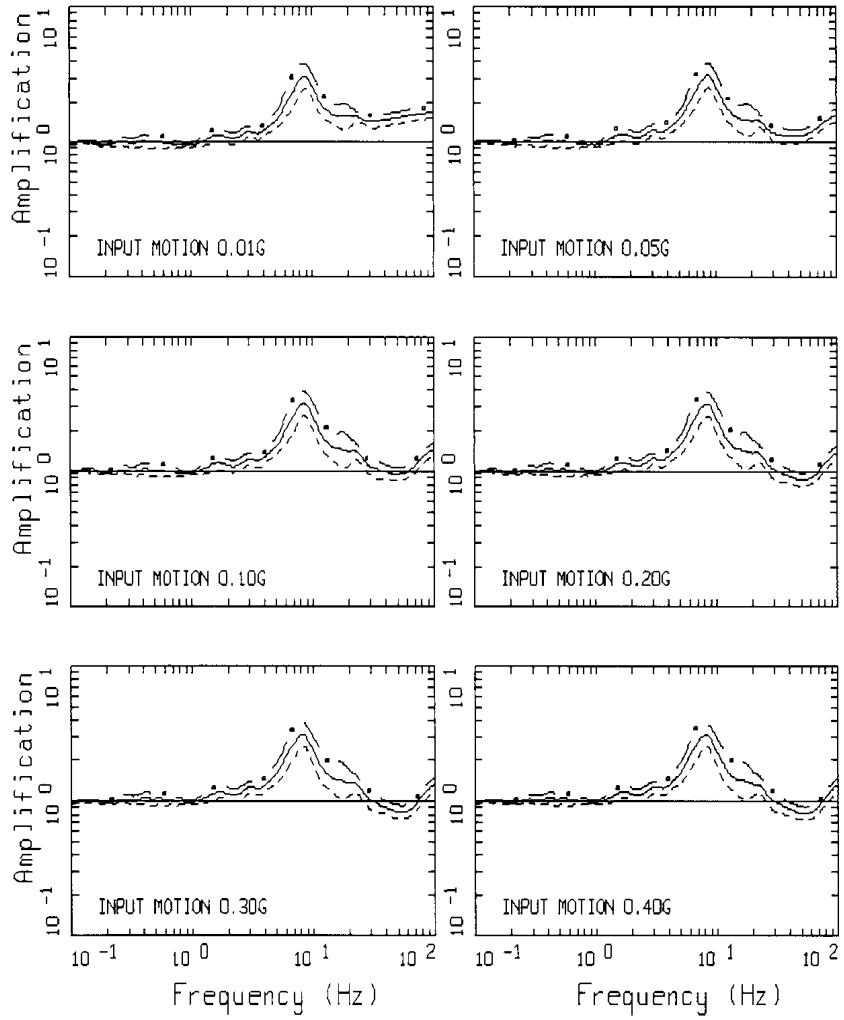
AMPLIFICATION(H), NEHRP BC, 760 M/S OVER 3000 M/S  
 PR CURVES: PAGE 1 OF 2

- LEGEND
- 760 M/S, WEATHERED FIRM ROCK: 50TH PERCENTILE
  - ..... 760 M/S, PIEDMONT, BLUE RIDGE, SAPROLITE: 50TH PERCENTILE
  - 760 M/S, GLACIATED REGION, TILL: 50TH PERCENTILE
  - UNITY LINE



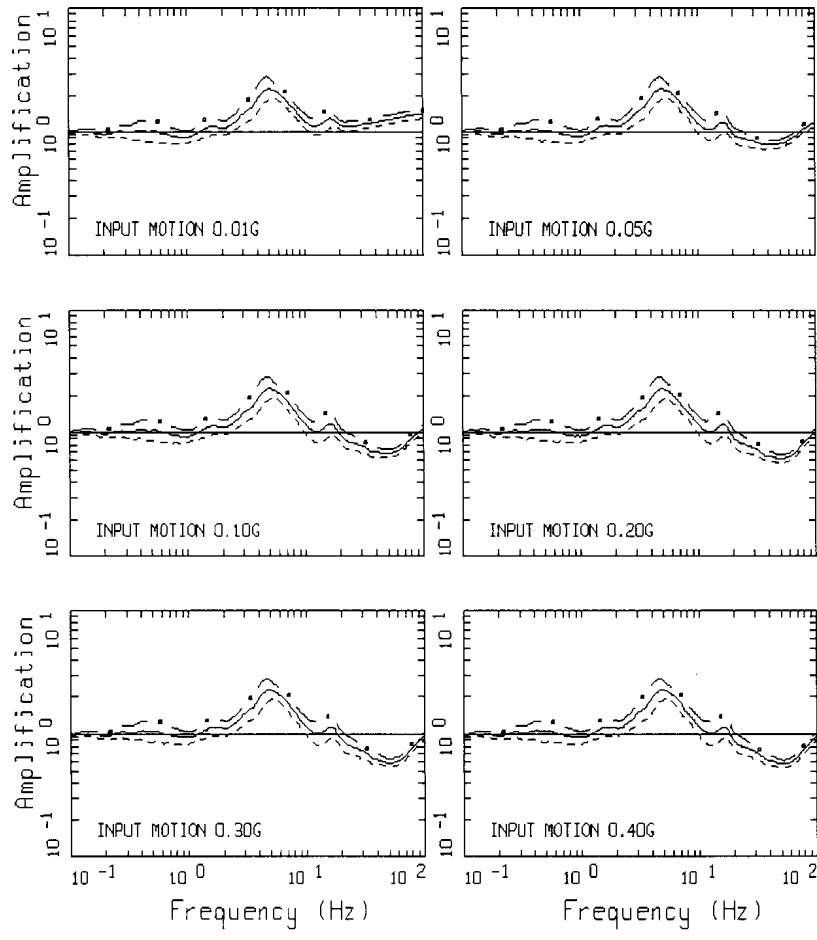
AMPLIFICATION(H), NEHRP B/C GRADIENT 760 M/S/3000 M/S, 2000 M  
 PR CURVES: PAGE 1 OF 2

LEGEND  
 - · - 84TH PERCENTILE  
 — 50TH PERCENTILE  
 - - - 16TH PERCENTILE  
 — UNITY LINE



AMPLIFICATION(H), NEHRP B/C SAPROLITE 760 M/S/3000 M/S, 200 M  
 PR CURVES: PAGE 1 OF 2

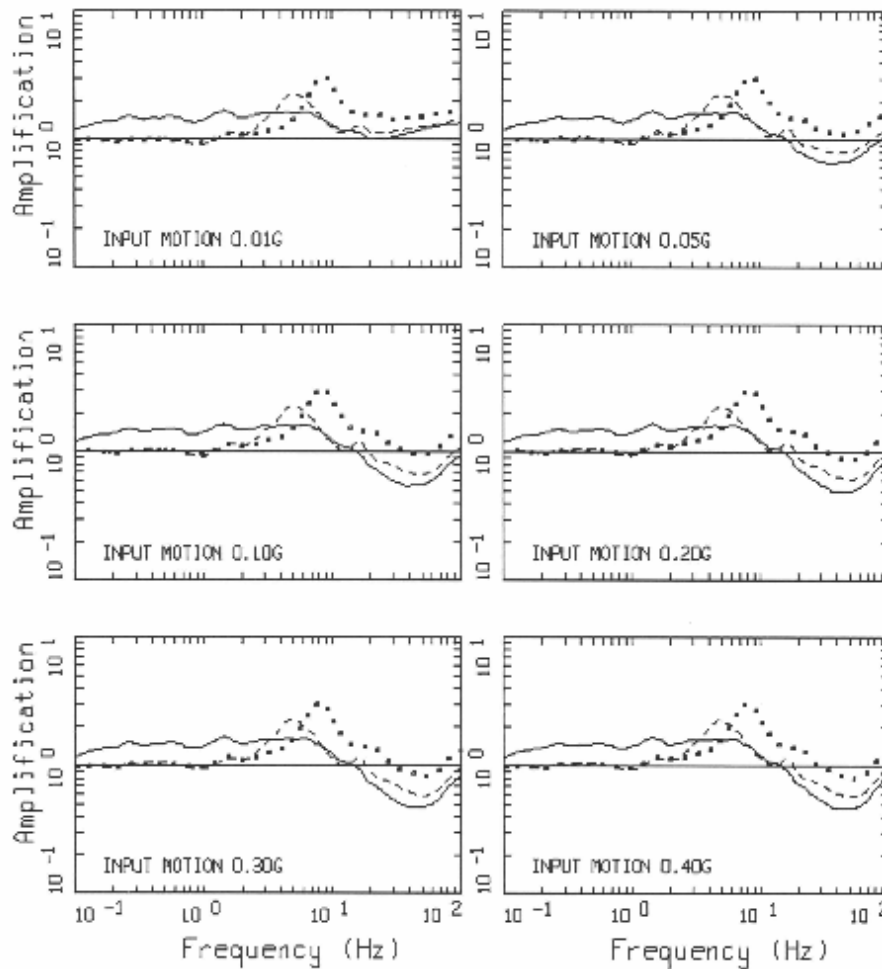
LEGEND  
 - . - 84TH PERCENTILE  
 ——— 50TH PERCENTILE  
 - - - - 16TH PERCENTILE  
 ——— UNITY LINE



AMPLIFICATION(H), NEHRP B/C TILL 760 M/S/3000 M/S, 80 M  
 PR CURVES: PAGE 1 OF 2

- LEGEND
- • — 84TH PERCENTILE
  - 50TH PERCENTILE
  - 16TH PERCENTILE
  - UNITY LINE





AMPLIFICATION(H), NEHRP BC, 760 M/S OVER 3000 M/S  
 PR CURVES: PAGE 1 OF 2

- LEGEND
- 760 M/S, WEATHERED FIRM ROCK: 50TH PERCENTILE
  - ..... 760 M/S, PIEDMONT, BLUE RIDGE, SAPROLITE: 50TH PERCENTILE
  - 760 M/S, GLACIATED REGION, TILL: 50TH PERCENTILE
  - UNITY LINE

# Thickness and Amplification Factors

7 Depths over Hard Rock  
for

$$V_s (30 \text{ m}) = 270 \text{ m/s}$$

NEHRP D

25 ft

50 ft

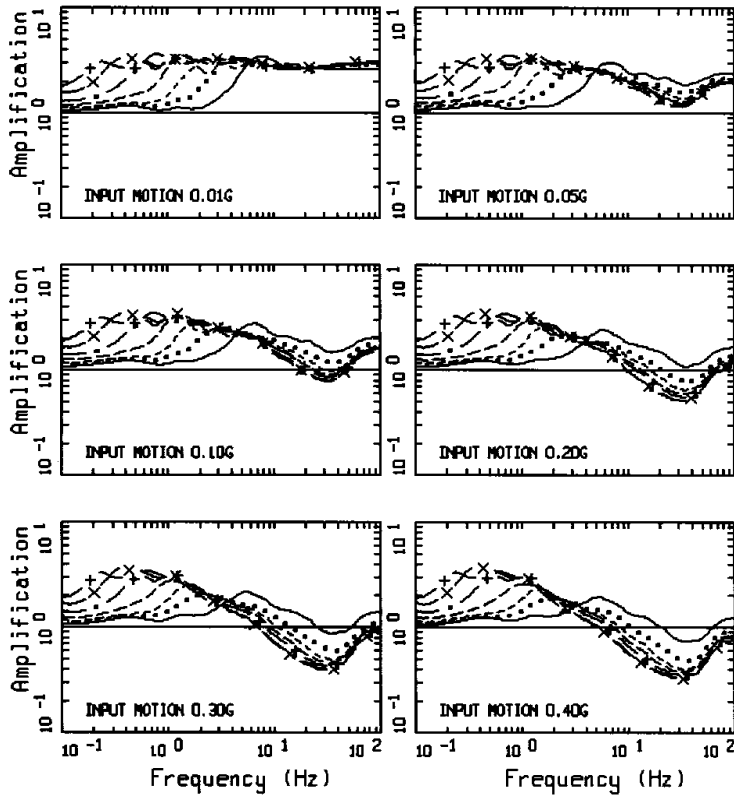
100 ft

200 ft

500 ft

1000 ft

2000 ft



AMPLIFICATION(H), 270 M/SEC, 7 DEPTHS OVER HARD ROCK  
 EPRI CURVES: PAGE 1 OF 2

- LEGEND
- 25 FT: 50TH PERCENTILE
  - ..... 50 FT: 50TH PERCENTILE
  - 100 FT: 50TH PERCENTILE
  - - - - 200 FT: 50TH PERCENTILE
  - . - . 500 FT: 50TH PERCENTILE
  - - x - 1000 FT: 50TH PERCENTILE
  - - + - 2000 FT: 50TH PERCENTILE

# Thickness and Amplification Factors

7 Depths over Hard Rock  
for

$V_s(30\text{ m}) = 400\text{ m/s}$

NEHRP C

25 ft

50 ft

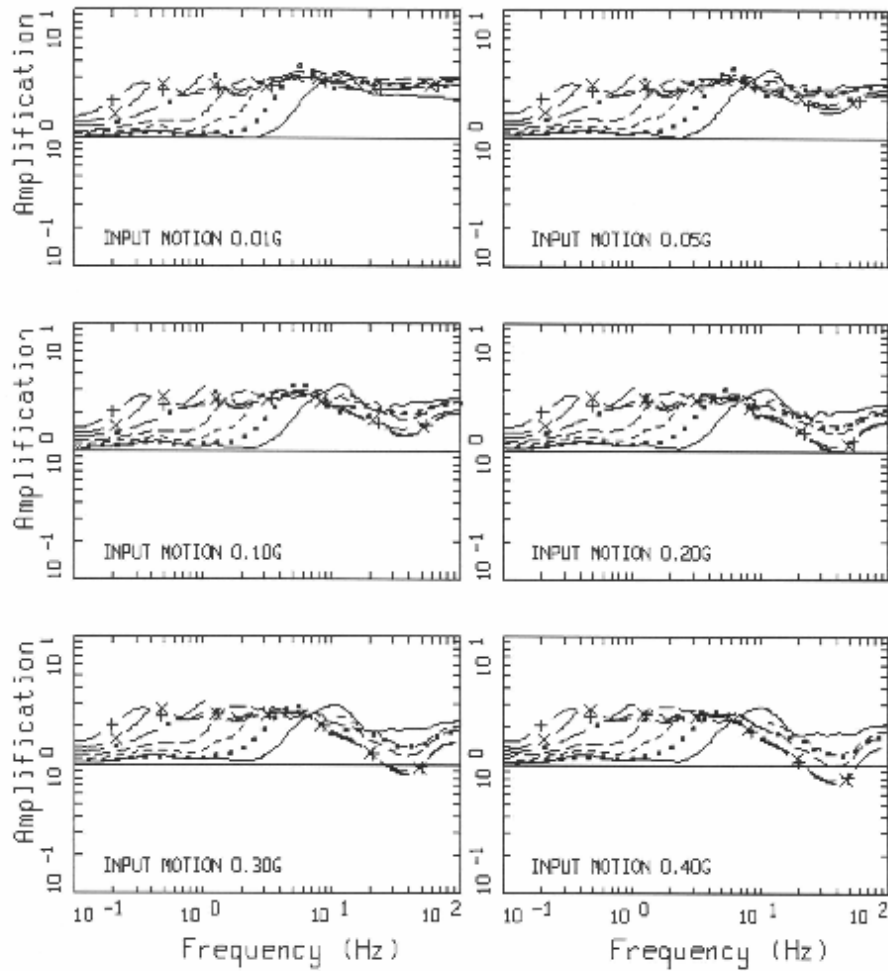
100 ft

200 ft

500 ft

1000 ft

2000 ft



AMPLIFICATION(H), 400 M/SEC, 7 DEPTHS OVER HARD ROCK  
 PR CURVES: PAGE 1 OF 2

- LEGEND
- 25 FT: 50TH PERCENTILE
  - ..... 50 FT: 50TH PERCENTILE
  - 100 FT: 50TH PERCENTILE
  - · - · - 200 FT: 50TH PERCENTILE
  - · - · - 500 FT: 50TH PERCENTILE
  - × - 1000 FT: 50TH PERCENTILE
  - + - 2000 FT: 50TH PERCENTILE