DST Dispersion Effects

In DST there is insignificant signal distortion due to dispersion for seismic traces recorded over typical depth intervals (i.e., 1 m to 5m) and typical Q values.

Typical Q Values:

Table 1: Absorption constants for rocks (after Sheriff & Geldart, 1982)

Rock Type	***Q (1/dB)***	***δ(dB)= ∀λ***	***∀/f (dB/km Hz)***
Igneous rocks	75-150	0.04-0.02	0.008-0.003
Sedimentary rocks	20-150	0.16-0.02	0.10-0.004
Rocks with gas in pore space	5-50	0.63-0.06	1.3-0.03

Table 2: Laboratory measurements of soil damping (after Stewart & Campanella, 1993)

Soil Type	***Strain (%)***	***Damping η (% Np)***	***Q(1/Np)***	***Q(1/dB)***	***Reference***
Cohesive	10^{-3}	3(1-5)	16.7(50-10)	1.92(5.76-1.15)	Sun *et al*. 1988
Clay	10^{-3}	0.9-2.4	55.6-20.8	6.4-2.4	Zavoral 1990
Sand	10^{-3}	1.5	33.3	3.8	Ishihara 1982
Cohesionless	10^{-4}-10^{-3}	0.5-2	100-25	11.5-2.9	Seed *et al.* 1986
Sand	10^{-3}	1	50	5.8	Saxena and Reddy 1989

Example:

Source Wave 1:

Berlage source wave with a dominant frequency of 55 Hz and assumed to be recorded at a vertical depth of 5m. The source is assumed to have a radial offset from the vertical of 1.5m.

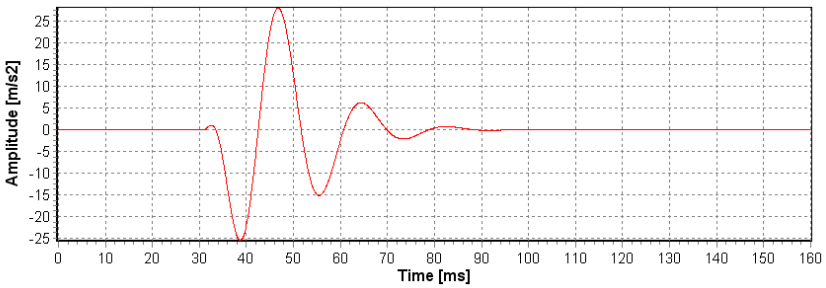

Figure 1: Berlage source wave with dominant frequency of 55 Hz and recorded at depth 5m.

Source Wave 2:

Source wave 2 is assumed to be recorded at a depth of 10m. This wave was generated by assuming a soil layer with a Q value of 30 1/Np, relative geometric spreading value of 0.5 (reduced for illustrative purposes (theoretical value is 1.0)) and a relative arrival time of 32ms. Figure 2 shows these two waves superimposed without a time offset, while Fig. 3 illustrates the two traces of Fig. 2 normalized (note that peaks and troughs align). In Fig. 4 a time offset of 32 ms (which equates to an internal velocity of 153 m/s) has been applied.

NOTE: Geometric spreading results in the predominant amplitude attenuation (equal for all frequency components) and no signal distortion just amplitude reduction.

As is illustrated below, for a typical Q value of 30 1/Np over a 5m source wave travel depth there is insignificant change in shape (peaks and troughs) of the source wave aside from the geometric spreading.

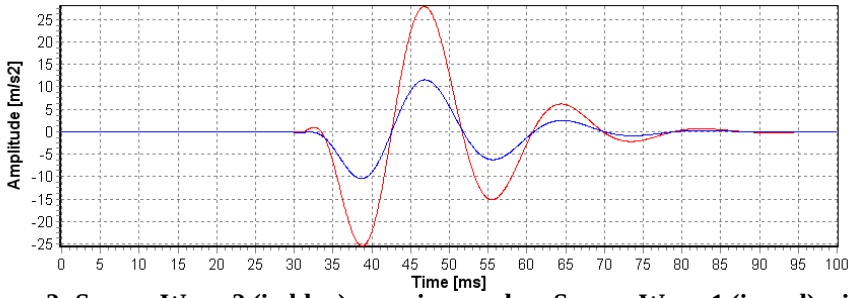

Figure 2: Source Wave 2 (in blue) superimposed on Source Wave 1 (in red) without time offset

Figure 3: Traces in Fig. 2 normalized.

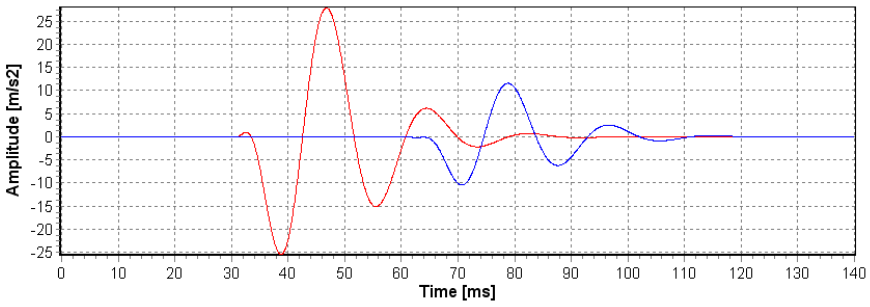

Figure 4: Source Wave 2 (in blue) superimposed on Source Wave 1 (in red) with 32 ms time offset

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