CS 120 Decrease of S-wave Velocity in Surface Layer by Strong Ground Motion at Ashigara Experiment Site, Japan

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Abstract

Acceleration records of two different levels(ground surface and GL-30m) of ground motions were analyzed to study effect of ground motion level on the shear wave velocity in the surface layer. The elongation of predominant period of the amplification function under strong ground motion is notified and the decrease of S-wave velocity was further confirmed by time domain analysis.

Records analyzed; Weak motion of the maximum acceleration at the surface of 2-5gals was recorded by a small local earthquake with magnitude of M=2.9 (depth=15.1km) with epicentral distance of 9km(Fig.1). Strong motion was obtained by a shallow earthquake(depth=13.6km) of M=5.1 with epicentral distance of about 8km which resulted maximum horozontal acceleration of about 100-200gals(FIG.1).

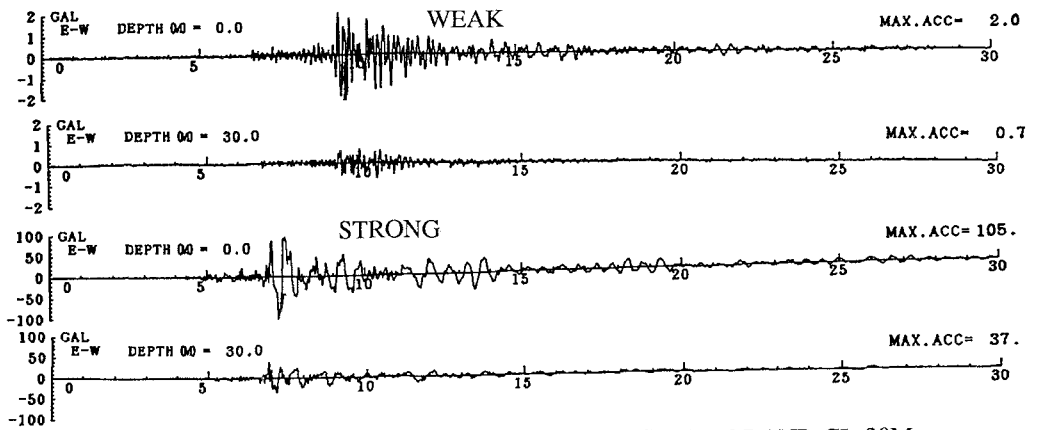

FIG.1 RECORDED MOTIONS AT THE SURFACE AND GL-30M

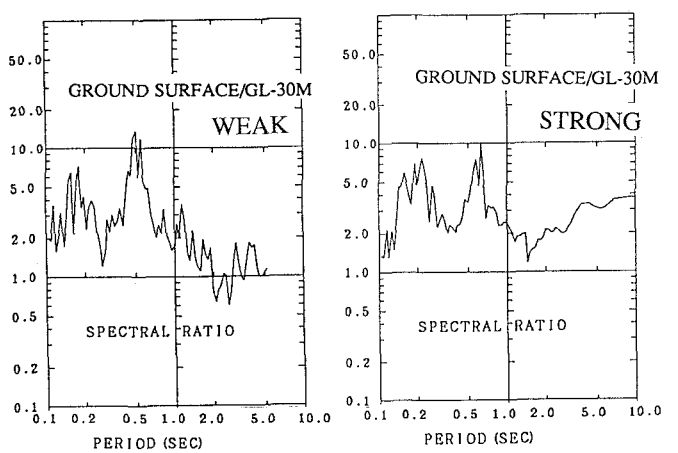

FIG.2 AMPLIFICATION FUNCTION (EW)GROUND SURFACE/GL-30M

TABLE-1 SHEAR WAVE STRUCTURE AT THE SITE

ASHIGARA NO.KS2 SITE

DEP (M)	TH (M)	RHO	C (M/SEC)
7.0	7.0	1.5	65.0
12.0	5.0	1.6	170.0
28.0	16.0	2.1	690.0
76.0	48.0	1.7	400.0
82.0	6.0	2.2	750.0
94.0	12.0	1.8	400.0
INF.HLF.SPACE		2.3	700.0

Site Characteristics; The site locates in a small vallay where top surface consists of silty soil of Vs=170m/sec covered by a loose filled material. The shear wave velocity of this fill material is 65m/sec. The shear wave subsurface strucutes is listed in Table-1. This top surface formation with thickness in 7m is considered the main layer whose velocity may change due to the intensity of ground motion.

Frequency Domain Analysis; Amplification factor of the ground motion at the surface were computed. Two peaks are found in the amplification spectrum for weak and strong ground motions. The peak periods are at 0.18sec and 0.5sec for weak motion(FIG.2) and 0.21sec and 0.7sec for strong motion(FIG.2) for EW component. The increase of the peak periods was 15 to 40%.

Time Domain Analysis; The acceleration time history at the depth of GL-30m was computed from the recorded acceleration at the surface and compared with the recorded wave at the GL-30m.

Changing the shear wave velocity at the top surface layer, the most possible wave velocity was estimated to give the maximum cross correlation coeffient between the computed and recorded waves at the GL-30m(FIG.3).

The shear wave velocity at the top surface was obtained in the range of 58-73m/sec for the weak ground motion. The velocity was found decreased as much as 40-58m/sec during the strong ground motion. The average velocity decrease was 25%.

Conclusion; Time domain analysis is straight forwards to identify the delay of arrival time in wave shapes compared with the frequency analysis. The dcrease of the velocity during strong ground motion corresponds well to the elongation of the peak period of the maximum amplication compared to the weak motion of the ground.

The maximum shear stran level computed in the top layer was in the range of 0.1-0.3%. Based upon the velocity change, the rigidity is decreased by about 85%. This corresponds to the strain dependecy obtained by laboratory test(FIG.4).

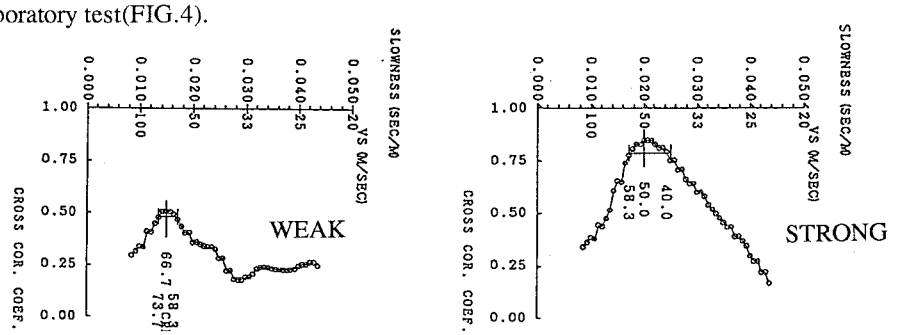

FIG.3 CROSS CORRELATION COEFFICIENT VS. SHEAR WAVE VELOCITY

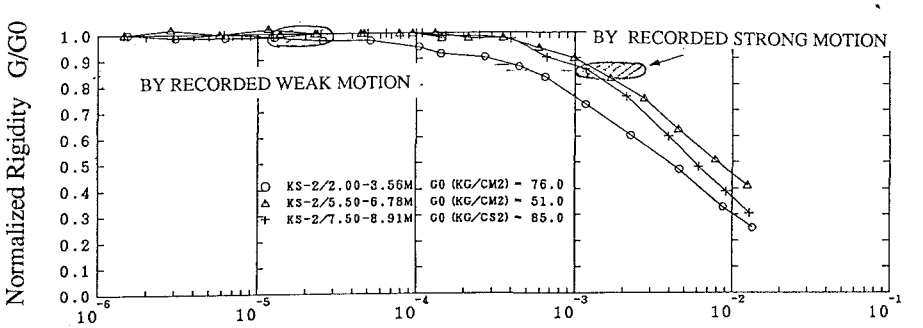

FIG.4 STRAIN VS SHEAR MODULUS BY LABORATORY TEST AND BY IN-SITU ACCERALATION RECORDS