SITE RESPONSE VARIATIONS BY GROUND IMPROVEMENT

Rasoul ALIPOUR
Ph.D. in Geotechnical Engineering, Shahrekord University, Shahrekord, Iran
r.alipour@sku.ac.ir

Heisam HEIDARZADEH
Ph.D. in Geotechnical Engineering, Shahrekord University, Shahrekord, Iran
heidarzadeh@ut.ac.ir

Keywords: Amplification, Shear velocity, Jet grouting, Ground improvement

In this study property of treated handy soil by jet grouting columns and its effects on the ground amplification have been investigated. Two types of JG columns including end bearing and floating types have been investigated. Various Improvement Area Ratio, IAR, and depth ratio of JG columns have been applied in this research. IAR changes from 0.2 to 0.5. Shear velocity of the JG columns and soil have been estimated due to the various IAR. Due to the shear velocity of JG columns, soil and IAR the value of shear velocity for composite cluster have been determined. Amplification of the soil layers were studied by the DEEPSOIL software. DEEPSOIL is a unified 1D equivalent linear and nonlinear site response analysis platform. Main features include: Strength-controlled nonlinear model; Frequency-independent damping formulation; Pore water pressure generation and finally Parallel-processing capability. Changes of the peak ground acceleration and ground displacement have been investigated in this research.

At the first step more than 40 boreholes have been performed in the site. Feasibility studies have been done with trial of single and triple jet grouting columns. Quality control of the columns has been done by drilling columns and performing unconfined tests on the soilcrete samples. In Table 1 properties of singular jet grouting has been illustrated.

Table 1. Parameters in trial of single Jet Grouting columns.

Row	Description	Unit	Value		
			WS-JG04	WS-JG05	WS-JG06
1	Air Pressure	Bar	-	-	-
2	Slurry Pressure	Bar	380	380	380
3	Slurry Discharge	Lit/min	56	60-70	40-50
4	Water Pressure	Bar	-	-	-
5	Water Discharge	Lit/min	60	60	60
6	Lifting Up Speed of Grouting Rod	mm/min	150	100	100
7	Rotational Speed of Grouting Rod	rpm	20	10	15
8	Water to Cement Ratio	-	1	1	1

Quality assurance of the soil stabilization have been done by cross hole tests in the field. Shear velocity of the samples derived from these tests. By increasing the shear velocity of treated soil by cement the peak ground acceleration of the transferred earthquake will decrease.

In Figure 1, top view of the industrial site has been illustrated.

Figure 1. View of soil stabilized site with approximate 5 m jet grouting columns.

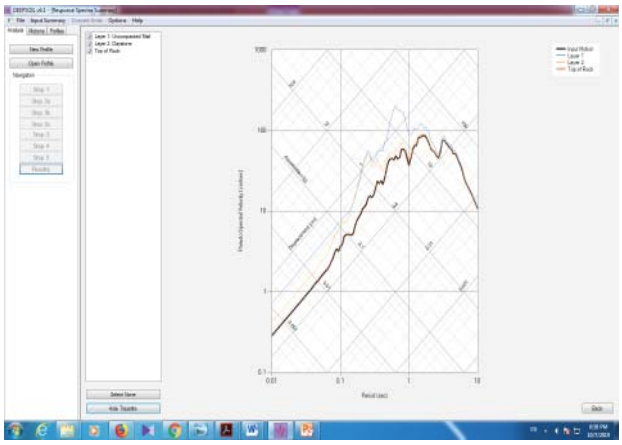

Figure 2. Response spectra in a tripartite plot of Period, acceleration and displacement for uncompacted ground.

At the end and as a conclusion by performing jet grouting columns and increasing shear velocity of the treated soil sample, amplification have been decreased. The results categorised as below:

First and for most by imposing Chi Chi earthquake with PGA equal to 0.2 g, the PGA in both ground including uncompacted marl and grouted ground have been increased to 0.4 g.

In addition profile of displacement of grouted ground has been decrease dramatically from +-45 mm to +-9 mm.

Grouted ground besides increasing bearing capacity and decreasing the settlement of structure has significant effect in earthquake by decreasing the displacement of the ground.

REFERENCES

Croce, P., Flora, A., and Modoni, G. (2014). Jet Grouting: Technology, Design and Control. CRC Press.

Hsieh, H.S., Wang, C.C., and Ou, C.Y. (2003). Use of jet grouting to limit diaphragm wall displacement of a deep excavation. *Journal of Geotechnical and Geoenvironmental Engineering*, *129*(2), 146-157.

Li, Y., Xu, S., Liu, H., Ma, E., & Wang, L. (2018). Displacement and stress characteristics of tunnel foundation in collapsible loess ground reinforced by jet grouting columns. *Advances in Civil Engineering*.

Qiu, J., Liu, H., Lai, J., Lai, H., Chen, J., & Wang, K. (2018). Investigating the long-term settlement of a tunnel built over improved loessial foundation soil using jet grouting technique. *Journal of Performance of Constructed Facilities*, *32*(5), 04018066.