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TECHNICAL NOTE

Estimation of Atterberg limits and bulk mass density of an expansive soil from P-wave velocity measurements

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Abstract This brief technical note reports the relationship between P-wave velocity and the Atterberg limits and bulk mass density of an expansive soil from the Derince region of Turkey. Reasonably good correlations were found, which were improved when the relationship was between P-wave velocity divided by water content.

Keywords Atterberg limits · P-wave velocity · Bulk density · Derince expansive soil

Geotechnical Studies

In this study, P-wave velocities measured on undisturbed samples of 23 expansive soil samples collected in three boreholes drilled in Derince region, Turkey, were correlated with their index properties, and empirical equations determined using regression analysis. The tests included water content, liquid limit (LL), plastic limit (PL) and bulk mass density (ρ_b). The mineral composition of the expansive soils, was determined using X-ray difractometer (XRD) in this study (Table 1).

P-Wave velocity measurements, Atterberg limits and regression analysis

P-wave velocities of the 60 mm diameter, 90–100 mm long samples were measured using a Pundit instrument (ASTM 1984). P-wave velocity values were correlated with liquid limit, plastic limit, plasticity index and bulk mass density for the soil samples. The plots indicating the correlations are given in Fig. 1. In order to improve the correlation, P-wave velocities were divided by water content. The ratio of P-wave velocity to water content was correlated with LL, PL, PI and ρ_b (Fig. 1).

Discussion and conclusion

A reasonably good correlation was found between P-wave velocity and the liquid limit, plastic limit and plasticity index, and bulk mass density. Similar results were also obtained for physical properties of soil versus P-wave velocity to water content.

Table 1 Mineral composition of expansive soils (%)

Montmorillonite	Illite	Kaolinite	Feldspar	Hydromica	Chlorite	Others
26.5	31.2	4.4	13.0	5.9	7.9	11.1
26.3	30.9	4.46	12.9	6.1	7.1	12.24
26.2	32.1	4.62	13.5	5.6	7.3	10.68
26.8	31.8	4.25	13.2	5.8	7.5	10.65

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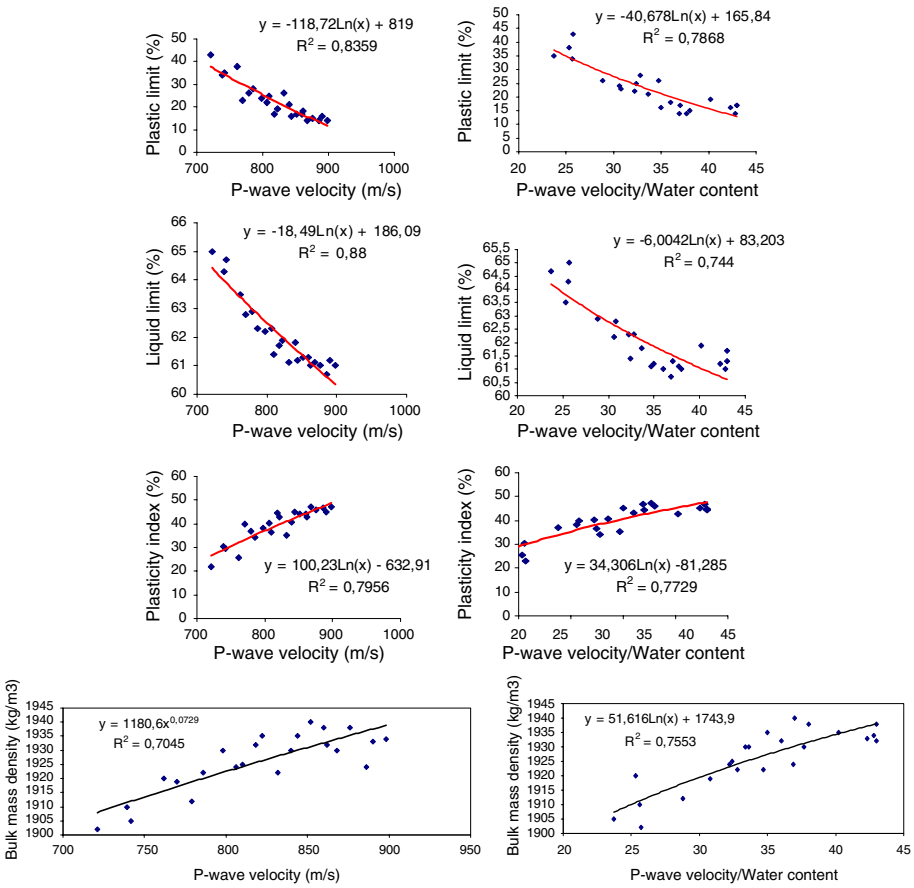

Fig. 1 Physical properties of samples versus P-wave velocity and P-wave velocity to water content

Reference

ASTM (1984) American Society for Testing and Materials. Standard test method for unconfined compressive strength of intact core specimens. Soil and Rock, Building Stones: Annual Book of ASTM Standards 4.08. ASTM, Philadelphia, Pennsylvania