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EFFECT OF FINES CONTENT AND PARTICLE DIAMETER RATIO ON SMALL STRAIN SHEAR MODULUS OF DENSE BINARY GRANULAR MIXTURES

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INTRODUCTION

During earthquake waves propagation, soil layers are deformed. The resulting deformation is mainly determined by dynamic parameters, which are described in the terms of small strain shear modulus (G_{max}), normalized shear modulus (G / G_{max}) and damping ratio (D) (Towhata, 2008).

Based on previous research, grain size distribution and particle shape have significant effect on small strain shear modulus (Ishihara, 1996; Santamarina & Cho, 2004; Wichtmann & Triantafyllidis, 2009). While the effect of soil fabric on dynamic parameters of uniform mixtures has been well investigated, there is still a gap in knowledge around the behavior of soil mixtures. According to the literature, recent investigations on binary granular mixtures- as the simplest mixtures- demonstrate that fines content and particle diameter ratio have great impact on small strain shear modulus (Liu & Yang, 2018). The aim of this research is to figure out the effect of fines content and particle diameter ratio on small strain shear modulus in dense binary granular mixtures.

EXPERIMENTAL PROCEDURE

Spherical glass balls are used in this research with grain size distribution and physical properties as shown in Figure 1 and Table1, respectively. A free-free Resonant Column device is used to obtain the shear modulus of samples prepared by dry deposition method in small strains.

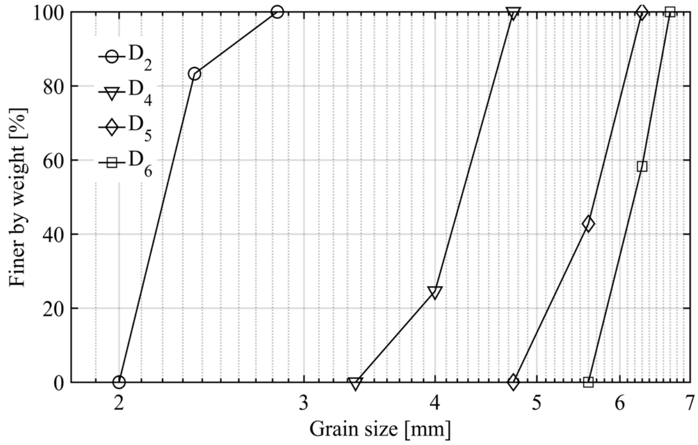

Figure 1. Grain size distribution of tested materials.

Table 1. Physical properties of tested materials.

Materials	G_s	$d_{50}\,(mm)$	C_u	e_{min}
D_2	2.49	2.21	1.1	0.63
D_4	2.49	4.24	1.2	0.61
D_5	2.49	5.67	1.2	0.62
D_6	2.49	6.20	1.2	0.61

Table 2. Experimental test program.

Sample	Particle Size Ratio	e_{min}	$\sigma_3'\,(kPa)$
D_2	1	0.625	60, 100, 300, 600
D_4	1	0.610	60, 100, 300, 600
D_5	1	0.615	60, 100, 300, 600
D_6	1	0.612	60, 100, 300, 600
$D_4 + D_2(25, 45, 50, 75)$	1.92	(0.557, 0.528, 0.540, 0.583	60, 100, 300, 600
$D_5 + D_2(25, 35, 50, 75)$	2.57	(0.498, 0.473, 0.495, 0.550)	60, 100, 300, 600
$D_6 + D_2(25, 30, 50, 75)$	2.81	(0.480, 0.450, 0.480, 0.534)	60, 100, 300, 600

RESULTS

Test results revealed that for a constant particle diameter ratio, G_{max} rises with increasing fines content, up to threshold fines content and then it falls as the fines content passes the threshold value. In addition, an increase of G_{max} with particle size was observed for constant fines content.

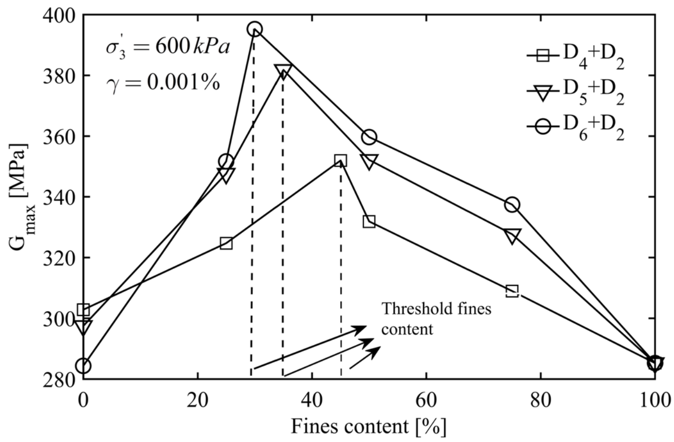

Figure 2. Small strain shear modulus versus fines content for dense binary granular mixtures.

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