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DISCUSSION

Discussion of "Threshold fines content and behavior of sands with nonplastic silts"[1]

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Polito and Sibley (2020) have presented a good paper; however, this discussion presents a few simple observations as listed below.

1. Formation of soil samples

Polito and Sibley (2020) stated that the soil specimens were formed by performing dry deposition, where the soils were deposited in the molds through a funnel with zero drop height, and specimens of a relative density equal to 40% were obtained. Actually, this process is very similar to the one described in ASTM (2000) standard D4254 for obtaining minimum density of the soil. Accordingly, the expected density of soil samples from the procedure described by Polito and Sibley (2020) is the minimum density (i.e., relative density is zero). As such, it is very important to get more clarification and details about how Polito and Sibley (2020) obtained 40% relative density.

2. Calculating threshold fines content

Polito and Sibley (2020) presented two relationships to determine threshold fines content (TFC); namely, eq. 1 for upper-bound TFC (UBTFC) and eq. 2 for lower-bound TFC (LBTFC) (both of these equations are also presented here as eqs. D1 and D2), and it was stated that these two equations were derived from the limiting fines content relationships presented by Hazirbaba (2005)

$$\text{(D1)} \qquad \text{UBTFC} = \frac{G_{sf}(e_{max})}{G_{sf}(e_{max}) + G_{ss}(1 + e_f)}$$

$$\text{(D2)} \qquad \text{LBTFC} = \frac{G_{sf}(e_{min})}{G_{sf}(e_{min}) + G_{ss}(1 + e_f)}$$

where G_{sf} is the specific gravity of the fines, e_{max} is the maximum index void ratio of the sand, G_{ss} is the specific gravity of the sand, e_f is the void ratio of the fines, and e_{min} is the minimum index void ratio of the sand.

The discusser found the two relationships presented by Hazirbaba (2005) and they are stated here as eqs. D3 and D4

$$\text{(D3)} \qquad \text{TFC} = \frac{G_{sf}(e_{max})}{G_{sf}(e_{max}) + G_{ss}(1 + e_f)}$$

$$\text{(D4)} \qquad \text{TFC} = \frac{G_{sf}(e_{max})}{G_{ss}(1 + e_f)}$$

As can be seen, eq. 1 presented by Polito and Sibley (2020) is identical to eq. D3 presented by Hazirbaba (2005). In eq. D3, e_f is the maximum void ratio of fines (silt), while Polito and Sibley (2020) defined e_f (as presented in eq. D1) as the void ratio of fines. This definition is not very clear: is e_f the maximum, minimum or another specific value of void ratio of fines? As an attempt to determine this value, the discusser performed back-analysis of the data and results of Polito and Sibley (2020). Polito and Sibley (2020) calculated the values of UBTFC and LBTFC as 28.6% and 21.8%, respectively. The back-analysis is shown below
From eq. D1:

$$\text{UBTFC} = 28.6\% = \frac{G_{sf}(e_{max})}{G_{sf}(e_{max}) + G_{ss}(1 + e_f)} \Rightarrow e_f = 0.844$$

From eq. D2:

$$\text{LBTFC} = 21.8\% = \frac{G_{sf}(e_{min})}{G_{sf}(e_{min}) + G_{ss}(1 + e_f)} \Rightarrow e_f = 0.611$$

It can be seen that two different values of e_f (namely, 0.844 and 0.611) are obtained for the same silty soil. Also, the value obtained from backanalysis of eq. D2 ($e_f = 0.611$) is, strangely, smaller than the minimum void ratio of silt ($e_{min} = 0.67$); such results should be explained clearly.

Another important observation is about the limiting values as calculated from Hazirbaba (2005) by Polito and Sibley (2020). The values for lower- and upper-bound fines content were 20.9% and 27.3%, respectively (see table 1 in the paper under discussion); however, the values have been re-calculated by the discusser (see eqs. D3 and D4) and found to be 22.9% and 29.7%, respectively. Accordingly, to get a clearer idea of Polito and Sibley's work, it is very important that they provide some details about their calculation.

3. Observation about data presented in fig. 1 (Polito and Sibley 2020)

Polito and Sibley (2020) obtained the friction angle of sand–silt mixtures for silt content ranging from 0% to 45%. They also tried to draw conclusions about the pattern of friction angle when the silt content is lower than the LBTFC and when it is higher than the UBTFC (as they computed from eqs. D1 and D2, respectively). For the values lower than the LBTFC, there were no problems with their analysis, where the coefficient of variation CV = 0.01 and the

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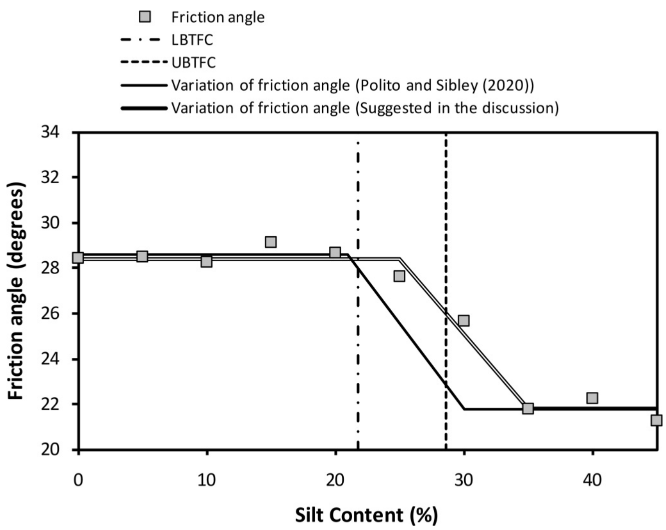
Fig. D1. Variation of friction angle with silt content (adapted from Polito and Sibley 2020).



average value of angle of internal friction $\phi' = 28.6°$. However, when the silt content was higher than the UBTFC, the coefficient of variation CV = 0.09 and the average value of angle of internal friction $\phi' = 22.8°$. To explain these results, Polito and Sibley (2020) concluded that the value of CV was 0.09 because the friction angle at a silt content of 30% (just slightly more than UBTFC = 28.6%) is 25.7°, while the average value of ϕ' for samples with a silt content ≥35 is $\phi' = 21.8°$ — this value was adopted in fig. 1 (Polito and Sibley 2020) as the average value of friction angle for silt content higher than the UBTFC and the internal friction angle value corresponding to silt content = 30% was considered as a transition value. The results of fig. 1 of Polito and Sibley (2020) are represented here also, as Fig. D1.

The analysis presented in fig. 1 (in the paper under discussion) can be presented in another way if we know that values of UBTFC = 28.6% and LBTFC = 21.8% are neither obtained from experimental tests nor obtained from the closed-form solution, but are obtained from eqs. D1 and D2, which were derived based on some sort of "ideal" assumptions, such as the void ratio of the sand that is either minimum or maximum, while the actual one is something else and could be something in-between or close to a relative density of 40% (the relative density at which the specimens are compacted). As such, it may be expected that the actual values of UBTFC and LBTFC are different from those theoretical values. Another possible variation of change of ϕ' and silt content is proposed by the discusser, which is based on the experimental tests only and does not ignore the angle of friction at a silt content = 35%, as presented in Fig. D1.

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