Postprint of: Bałachowski L., Discussion of "CPT Evaluation of Yield Stress Profiles in Soils" by Shehab S. Agaiby and Paul W. Mayne, JOURNAL OF GEOTECHNICAL AND GEOENVIRONMENTAL ENGINEERING, Vol. 146, iss. 12 (2020), 07020022, https://doi.org/10.1061/(ASCE)GT.1943-5606.0002411

Discussion of"CPT evaluation of yield stress profiles in soils"

by Shehab S. Agaiby and Paul W. Mayne

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The Authors presented a comprehensive approach concerning the estimation of yield stress profile in different soils. They considered a large database including worldwide well-documented test sites and calibration chamber tests. I would like to focus the discussion on the evaluation of OCR ratio in sands in the continuous mini-cone penetration using the results of centrifuge tests. Physical modelling in centrifuge permits to perform some parametric studies including the effect of soil overconsolidation. The aim of this discussion is to verify the correlations for OCR in sands - proposed by the Authors - in case of defined uniform OCR within the soil profile. A series of centrifuge CPT tests (Bałachowski, 1995) was conducted in dense D_R=0.82 uniform quartz sand using mini-CPT model (B=12 mm). The soil mass with medium Hostun sand (d_{50}=0.32 mm) was prepared using sand raining technique. The overconsolidated soil mass was obtained by reducing the centrifuge g-level from 100g to 60g or 30g (with overconsolidation ratio, OCR=1.67 or 3.33, respectively). In this way a uniform OCR ratio was achieved in the soil profile. The mini-cone penetration tests were conducted in normally consolidated sand, i.e. at 100g and in overconsolidated sand after reduction of centrifuge acceleration to 60g (OCR=1.67) and then to 30g (OCR=3.33).

The results of cone resistance in Hostun medium sand are shown in Fig. 1. One can notice that at a given vertical stress higher cone resistance is mobilized in overconsolidated soil mass. In case of shallow penetration scheme the normalized cone resistance increases almost linearly with vertical stress (Fig. 2). It can be also noticed that the critical depth increases with OCR ratio. Calibration chamber tests (Jamiolkowski et al. 1985) have shown that under critical depth the cone resistance is proportional to the square root of vertical stress. It was also confirmed in cone penetration tests in centrifuge (Gui et al. 1998, Bolton et al. 1999, Bałachowski, 2007, Salgado, 2014 and Kim et al. 2015).

The OCR ratio for cone penetration tests (Fig. 3) was calculated using the Eq. 7 proposed by the Authors. In case of shallow penetration mode the calculated OCR values increase with vertical stress and reach the maximum value near the critical depth, and then attenuate with further penetration. The calculated OCR is closer to the simulated value at large penetration depths (vertical stress). It is interesting to note that for normally consolidated sand the calculated OCR values are higher than one and similar shape of calculated OCR profile is observed in normally consolidated and overconsolidated sands. The general observation is that the proposed formula for yield stress (Eq. 7) can be used only in case of deep penetration scheme and seems to overestimate OCR ratio in sands. If the grain size effects is rather negligible (Gui et al. 1998) in the considered tests (B/d_{50}=37.5) the geometrical size effects could however influence the results at lower stress level. Further studies including the procedure “modelling of models” will be necessary to study this effect.

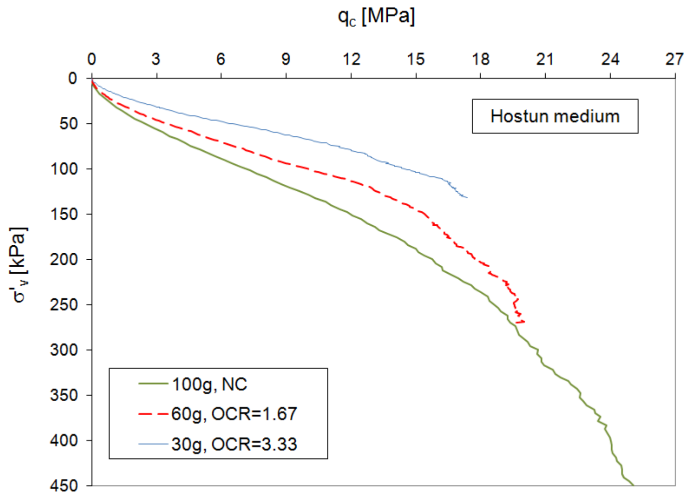

Fig. 1. Mini-cone penetration tests in Hostun medium sand.

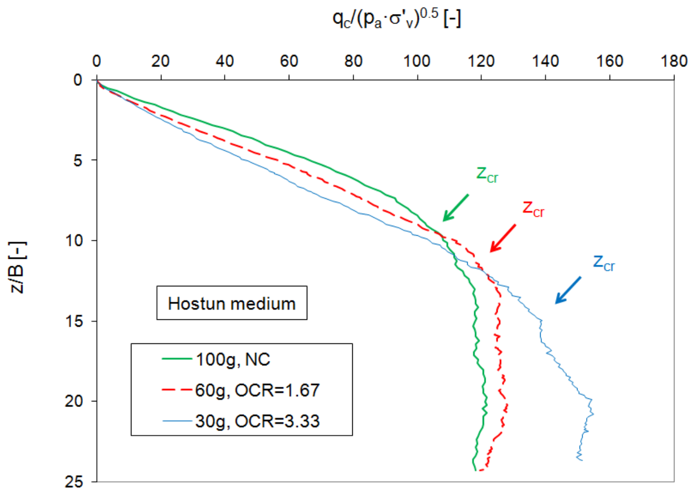

Fig. 2. Normalized cone resistance vs. normalized penetration depth.

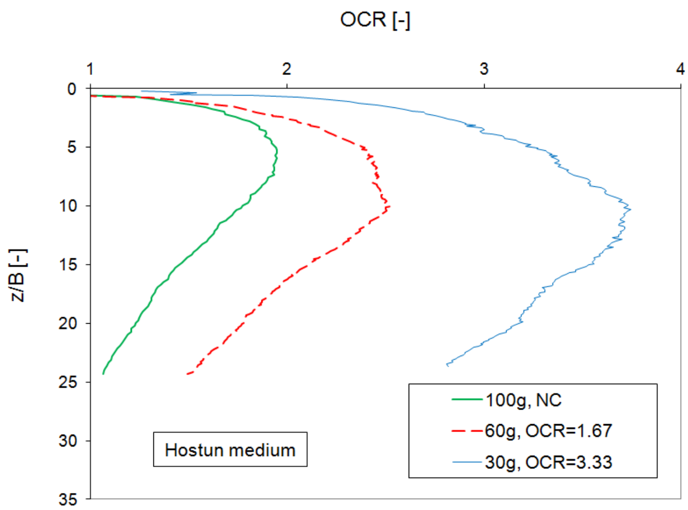

Fig. 3. OCR ratio derived from mini-cone penetration tests.

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