DISCUSSION of Degago et al. (2009), Vol. 1, 324-327

by G. Mesri, Department of Civil and Environmental Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois, USA and
T. W. Feng, Department of Civil Engineering, Chung Yuan Christian University, Chung-li, Tao-yuan County, Taiwan

The title of the contribution by Degago et al. (2009) to this conference plays on the title of Mesri and Choi (1985): "The uniqueness of end-of-primary (EOP) void ratio – effective stress relationship", and therefore, deserves a response from Mesri and co-workers who have published laboratory and field data and interpretation in support of hypothesis A (e.g., Mesri, Feng and Shahien 1995).

Degago et al. (2009) reinterpreted data in Feng (1991), and used a computer program based on the Soft Soil Creep (Stolle et al. 1999) to predict consolidation behavior of laboratory specimens. Degago et al. (2009) used the C_α/C_c law of compressibility, developed by Mesri and co-workers for predicting secondary compression behavior (e.g., Mesri 2001), to define their so-called creep parameter during primary compression.

We do not agree with Degago et al.'s reinterpretation of the data in Feng (1991). Mistakes were made in defining the EOP void ratio for the 125 mm thick specimens of Batiscan clay and St. Hilaire clay. Having decided that the pressure increment durations for the 500 mm thick specimens were not long enough, Degago et al. (2009) subtracted from the EOP void ratio of the 125 mm specimens at consolidation pressure of 62.1 kPa and 96.6 kPa, respectively, for Batiscan clay and St. Hilaire clay. In other words, for the 125 mm thick specimens, the EOP void ratio was incorrectly defined at a time significantly less than t_p. Then, the additional compression that took place at 62.1 kPa and 96.6 kPa, respectively, for Batiscan clay and St. Hilaire clay were not included in the EOP compression at 96.6 kPa and 138.0 kPa, respectively, of Batiscan clay and St. Hilaire clay.

The fundamental question for Degago et al. (2009) was "... whether or not creep acts as a separate phenomenon during primary compression, while excess pore pressure dissipates." Creep as a separate phenomenon originates from the concept of springs and dashpots – i.e., one spring associated with effective stress increase and a separate spring, completely unaware of the first spring, associated with progress of time. In fact, soil has only one structure which controls both compressibility with effective stress and compressibility with time.

Degago et al. (2009) propose that 'strictly speaking, it is the degree of dissipation of the excess pore pressure that should establish a true EOP criterion." Degago et al. (2009) do not seem to be aware of Mesri et al. (2005): "Excess porewater pressure during secondary compression." Two of the conclusions of that article are: a) The value of excess porewater pressure at the beginning of secondary compression stage (i.e., end of primary consolidation) corresponds to u'_m/σ'_v values in the range of 1 to 3%, where u'_m is the maximum excess porewater pressure within the layer and σ'_v is the consolidation pressure, and b) For soft clay deposits, with u'_m/σ'_v near 2%, EOP u'_m is often near 1 kPa and is not expected to exceed 10 kPa. The important implication of these conclusions is that it is not so straight forward to use the measurements of excess porewater pressure to "... establish a true EOP criterion."

Degago et al. (2009) then proceeded to examine the excess porewater pressure at EOP compression of the 125 mm and 500 mm specimens. The excess porewater pressures were in the range of 0.1 to 0.8 kPa for Batiscan clay and 1.0 to 2.2 kPa for St. Hilaire clay. Degago et al. (2009) concluded that primary consolidation "... time for the 500 mm thick specimen has been too short ...". We present two examples of our excess porewater pressure measurements to illustrate the rather impractical micro-management by Degago et al. (2009) of our data (Figs. 1 and 2). Note that, e.g., for the pressure increment from 62.1 kPa to 82.8 kPa after about 382 days the excess porewater pressure at the impermeable boundary (i.e., maximum excess porewater pressure) is less that 1 kPa. Therefore, we consider Degago et al.'s statements in

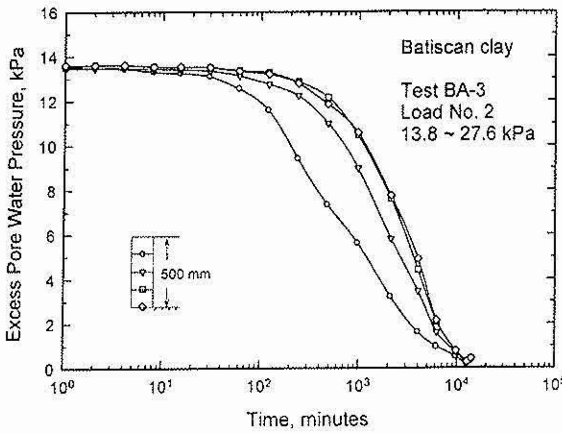

Fig. 1 Observed time-rate of dissipation of excess porewater pressure for the 500 mm thick Batiscan clay

Proceedings of the 17th International Conference on Soil Mechanics and Geotechnical Engineering
M. Hamza et al. (Eds.)

doi:10.3233/978-1-60750-031-5-3559

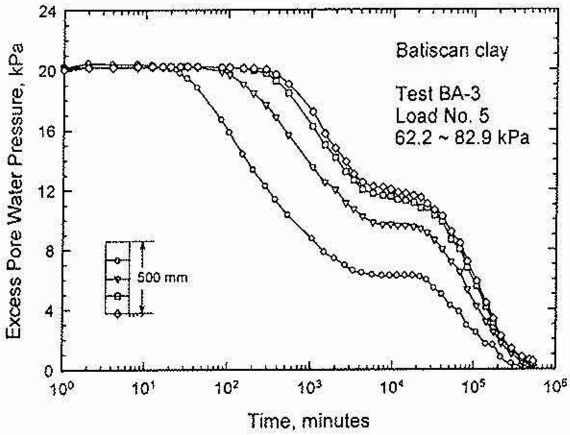

Fig. 2 Observed time-rate of dissipation of excess porewater pressure for the 500 mm thick Batiscan clay

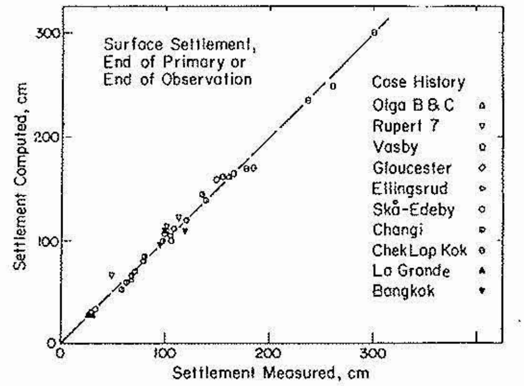

Fig. 3 Computed and measured EOP or EOO surface settlement of embankments on soft clay and silt deposits (Mesri et al. 1994)

connection to our tests quite unreasonable.

Thus, having satisfied themselves that "... creep acts as a separate phenomenon ..." during primary consolidation, Degago et al. (2009) proceeded to make predictions of compression rate "... using concepts derived from Isotaches concept ...". Degago et al. (2009) report that "the material model used is the Soft Soil Creep (SSC) ... the Model incorporates creep during the consolidation process and yields a non-unique EOP strain for different specimen thickness." However, Degago et al. (2009) do not illustrate as to how non-unique is SSC model. In other words, for a field situation, does it predict EOP vertical strain 1 percent greater than the EOP strain of a 20 mm oedometer specimen or does it predict 100% greater vertical train. Therefore, two main conclusions of Degago et al. (2009) are quite unjustified and troubling. These are: (a) Re-evaluation of the measurements gave "... results that support Hypothesis B" and (b) "According to the Isotaches concept ... any distinction between thick and thin specimen is revealed through the respective preconsolidation stress ...". Hypothesis B as originally defined (Ladd et al. 1977) could predict settlements for field conditions that are as much as 100 percent larger than those predicted using the uniqueness of EOP compression. We present computed (using uniqueness) and measured field settlements to dispute Degago at al.'s (2009) first conclusion (Fig. 3). We also present field and laboratory data on preconsolidation pressure of soft clay deposits to dispute Degago et al.'s (2009) second conclusion (Fig. 4).

The computer program based on Soft Soil Creep (SSC) model should be applied to a field situation with primary consolidation duration of 30 to 50 years before reaching any general conclusions on EOP compression and on the uniqueness of preconsolidation pressure. The contribution by Degago et al. (2009) does not include an application of SSC to field situations. However, Neher et al. (2001) use SSC to predict settlement of two test embankments. In connection with one embankment they conclude that "... SSC-model is not so useful." It is the settlement predictions by Neher et al. (2001) for the second embankment - Skå Edeby Area IV – that is quite revealing about the SSC model.

Mesri and co-workers have carried out settlement analyses using the ILLICON computer program for all of the test fills at Skå-Edeby test site in Sweden (e.g., Mesri et al. 1994). Neher at al. (2001) concluded that "... the SSC-model and measured

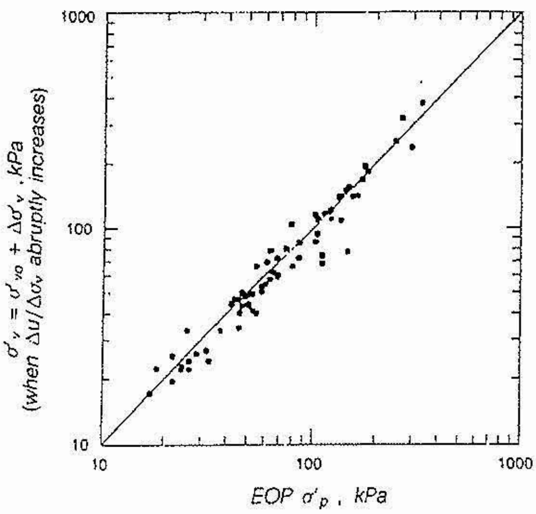

Fig. 4 Preconsolidation pressure mobilized in the field compared with EOP σ'_p from 20 mm thick oedometer specimens (Mesri et al. 1995)

data agree fairly well." However, the SS-model (i.e., SSC-model without "creep") predicted, for an elapsed time of 20 years, a settlement of 15 cm as compared to the observed settlement of 90 cm. The incredible implication of this result is that using Hypothesis A one may underpredict settlement by a factor of 6. No such experience assuming Hypothesis A has ever been reported in geotechnical literature (see, e.g., Leonards 1972). In order to understand the unusual prediction by Neher et al. (2001), one needs only to examine their input data on $C_c/(1+e_o)$ of the Skå Edeby clay. It turns out that $C_c/(1+e_o)$ magnitudes in Table 3 of Neher et al. (2001) are about 1/6 of the true values for the Skå Edeby clay. In other words, in order for the SSC-model and measured data to agree, Neher et al. (2001) used $C_c/(1+e_o)$ values about 1/6 of the true magnitudes, and this resulted in the unusual prediction of 15 cm settlement for the SS-model. If Neher et al. (2001) had used the true values of $C_c/(1+e_o)$, their SSC-model would have overpredicted settlements by a huge factor. For further interpretations of settlement observations for Area IV as well as Area I that support Hypothesis A the reader is referred to Mesri and Huvaj-Sarihan (2009).

The main conclusions of this discussion are: (a) The interpretation and analyses presented by Degago et al. (2009) do not necessarily support Hypothesis B, and (b) The computer program based on the SSC-model should be evaluated using field observations for full-scale field conditions, together with realistic assumptions on soil properties, before it is promoted as a practical tool for settlement analysis.

REFERENCES

Degago, S. A., Grimstad, G., Jostad, H. P. and Nordal, S. (2009). The non-uniqueness of the end-of-primary (EOP) void ratio-effective stress relationship, Proc. of the 17th International Conference on Soil Mechanics and Geotechnical Engineering, Alexandria, Egypt, 1:324-327.

Feng, T. W. (1991). Compressibility and permeability of natural soft clays and surcharging to reduce settlements. Ph.D. thesis, University of Illinois at Urbana-Champaign, Urbana, Illinois.

Ladd, C. C., Foott, R., Ishihara, K., Schlosser, F. and Poulos, H. G. (1977). Stress-deformation and strength characteristics. General Report, Proc. of 9th International Conference on Soil Mechanics and Foundation Engineering, 2:421-494.

Leonards, G. A. (1972). Discussion, Shallow foundations. Proceedings of Specialty Conference on Performance of Earth-Supported Structures, ASCE, Lafayette, Indiana, 3:169-173.

Mesri, G. (2001). Primary compression and secondary compression. Soil behavior and soft ground construction. Geotechnical Special Publication No. 119, ASCE:122-166.

Mesri, G. and Choi, Y. K. (1985). The uniqueness of the end-of-primary (EOP) void ratio-effective stress relationship. Proceedings of the 11th International Conference on Soil Mechanics and Foundation Engineering, San Francisco, 2:587-590.

Mesri, G., Feng, T. W. and Shahien, M. (1995). Compressibility parameters during consolidation. International Symposium on compression and consolidation of clayey soils, Hiroshima, Japan, Lectures and Reports Volume:201-217.

Mesri, G. and Huvaj-Sarihan, N. (2009). The Asaoka Method Revisited. Proceedings of the 17th International Conference on Soil Mechanics and Geotechnical Engineering, Alexandria, Egypt, 1:131-134.

Mesri, G., Huvaj, N., Vardhanabhuti, B., Ho, Y-H. (2005). Excess porewater pressure during secondary compression. Proceedings of the 16th International Conference on Soil Mechanics and Geotechnical Engineering, Osaka, Japan, 2:1087-1090.

Mesri, G., Lo, D.O.K. and Feng, T. W. (1994). Settlement of embankments on soft clays. ASCE Conference on Vertical and Horizontal Deformations of Foundations and Embankments, College Station, Texas:1-56.

Neher, H. P., Wehnert, M. and Bonnier, P. G. (2001). An evaluation of soft soil models based on trial embankments, computer methods and advances in geomechanics, Balkema:373-378.

Stolle, D.F.E., Vermeer, P. A. and Bonnier, P. G. (1999). Consolidation model for creeping clay, Canadian Geotechnical Journal, 36,4:754-759.