

28th ALERT Workshop, Aussois, October the 3rd 2017:

**Must Critical State Theory for
Granular Mechanics be Revisited?**

Why the workshop ?

Yannis F. Dafalias and Cino Viggiani

Αρχή σοφίας - Basis of wisdom

- “Αρχή σοφίας ονομάτων επίσκεψη”
- Αντισθένης, Φιλόσοφος, Ιδρυτής Κυνισμού, Αθήνα, 445-360 π.Χ
- “Basis of wisdom is the meaning of names”
- Antisthenes, Philosopher, Creator of Cynicism, Athens, 445-360 BC

The meaning of names

Critical State (CS)

It is the steady state of a soil where under fixed stresses and no volume change the material deforms in continued shearing

Critical State Theory (CST)

It is the theory that, among other things, proposes necessary and sufficient conditions on stress and density to reach and maintain CS.

Critical State Soil Mechanics (CSSM)

It is the Mechanics of Soils within a framework that recognizes the CS as an eventual failure state to be reached.

Critical State Line (CSL)

It is the locus of q , p , e values at CS; often it is the locus of p , e at CS

Critical State versus Critical State Theory

Critical State

(physical event)

$$\dot{q} = 0, \quad \dot{p} = 0$$

$$\dot{\epsilon}_v^p = 0$$

$$\dot{\epsilon}_q^p \neq 0$$

Note: $\dot{\epsilon}_q^p$ has
fixed direction

Critical State Theory

(debatable)

$$\eta = q / p = M(\theta)$$

$$e = e_c = \hat{e}_c(p)$$

Note: no condition
on fixity of $\dot{\epsilon}_q^p$ direction

What can be debated in Critical State Theory?

Existing conditions for CS

$$\eta = \frac{q}{p} = M(\theta, \text{other variables ?})$$

$$e = e_c = \hat{e}_c(p, \text{other variables ?})$$

Additional conditions for CS

Additional conditions
among the existing variables
and/or new ones

Specific debatable issues of CST

- Is Critical State Line unique ?
- Is Critical State Theory complete ?
- Does rate plays a role in reaching CS ?
- Does fabric affect the CST conditions for reaching CS ?
- Does higher order granular mechanics have an extended CST ?
- Do experiments confirm or deny the universality of CS and CST ?
- Do environmental actions affect CS and CST ?
- How is thermodynamics related to CS and CST ?
- How can grain breakage affect CS and CST ?
- Can CST be related to theories other than elastoplasticity?

On speakers' invitation

- **Choice of invitees was based on contributions to CST as a framework, and NOT on contributions to constitutive modeling within CST**
- **Some invitees could not come. Several more people could have been invited and the present choice tried to balance contributions to divers areas in CST**

PARTICIPATION

Audience is strongly encouraged to actively participate and express opinions, in particular different than those of the speakers, as well as pose challenging questions

Thank you

PROGRAM

Must Critical State Theory for Granular Mechanics be Revisited?

08:30 – 08:40: **Why the workshop?**

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08:40 – 09:10: **Critical State: misleading elegance?**, J. Carlos Santamarina

09:10 – 09:20: **audience participation**

09:20 – 09:50: **Fabric: a missing link between Critical State and Critical State Theory**

Y. F. Dafalias, A. G. Papadimitriou, A. I. Theocharis, E. Vairaktaris

09:50 – 10:00: **audience participation**

10:00 – 10:30: **Critical State of finely grained soils under “environmental loads”**

Cristina Jommi , Guido Musso, Claudio Tamagnini

10:30 – 10:40: **audience participation**

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10:40 – 11:10: **COFFEE BREAK**

11:10 – 11:40: **Is Critical State a utopia? A Barodesy answer**, Dimitrios Kolymbas

11:40 – 11:50: **audience participation**

11:50 – 12:20: **On critical state, rate and state, and thermodynamic state of soils**, Itai Einav

12:20 – 12:30: **audience participation**

12:30 – 12:40: **Closing comments**
Cino Viggiani and Yannis F. Dafalias