Developing confidence in critical state soil mechanics

2. Set Up xls for CamClay

Mike Jefferies, PEng

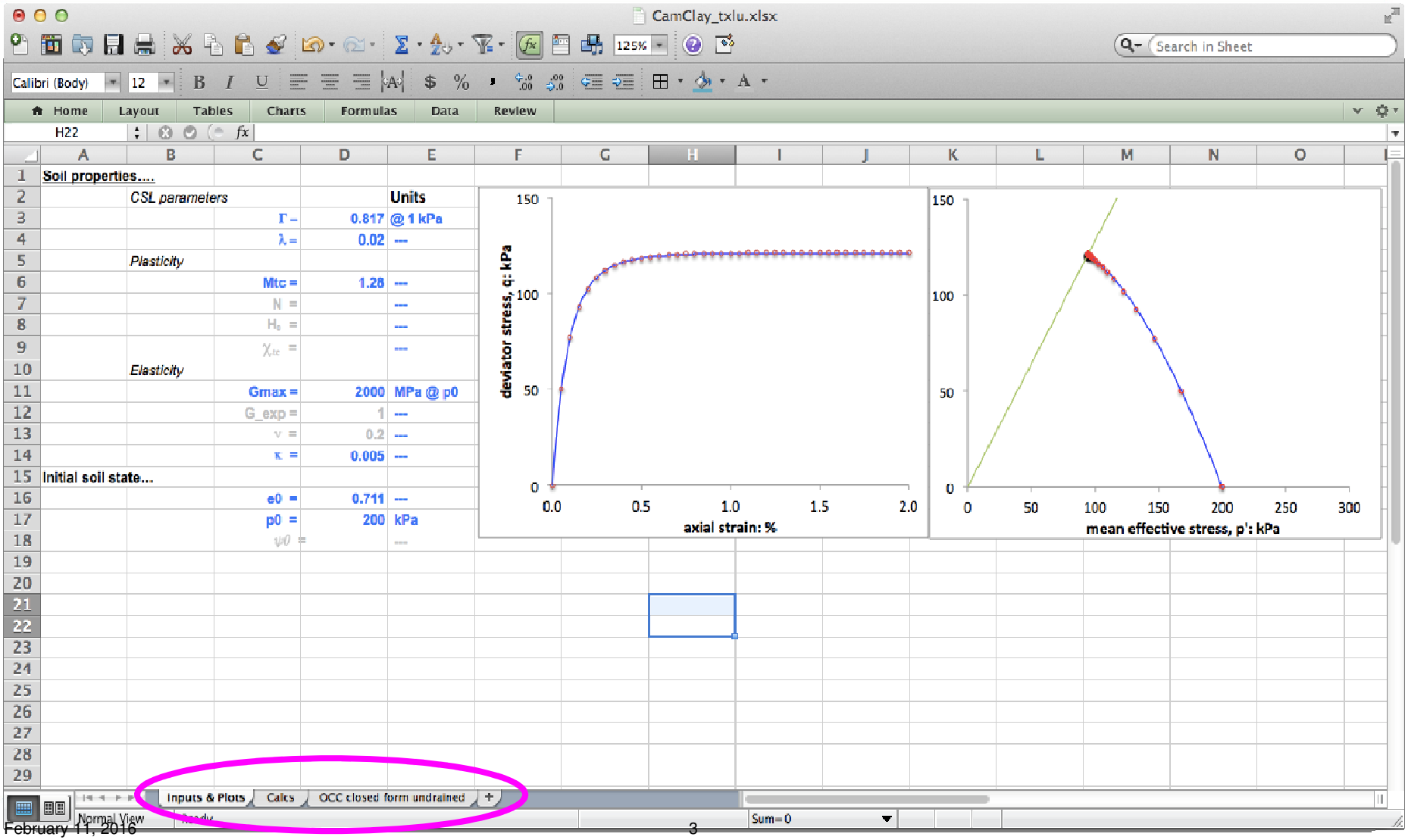
Dr. Dawn Shuttle, PEng

January, 2015

Find file…

- Folder: /data_and_progs
- *CamClay_txlu_template*.xls
  - Has framework
  - Build model on that for *undrained* triaxial compression
  - Has closed form results
- Describe how the xls is set up before going through Cam Clay equations…

CamClay_txlu.xls



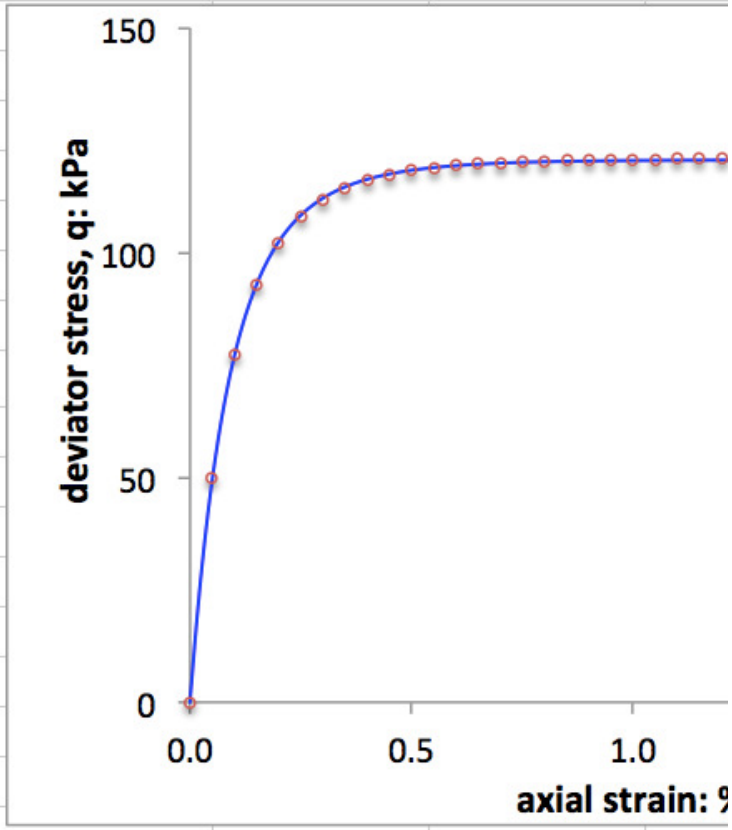
Soil Property Inputs

CamClay_txlu.xlsx

Home | Layout | Tables | Charts | Formulas | Data | Review

Mtc | 1.28

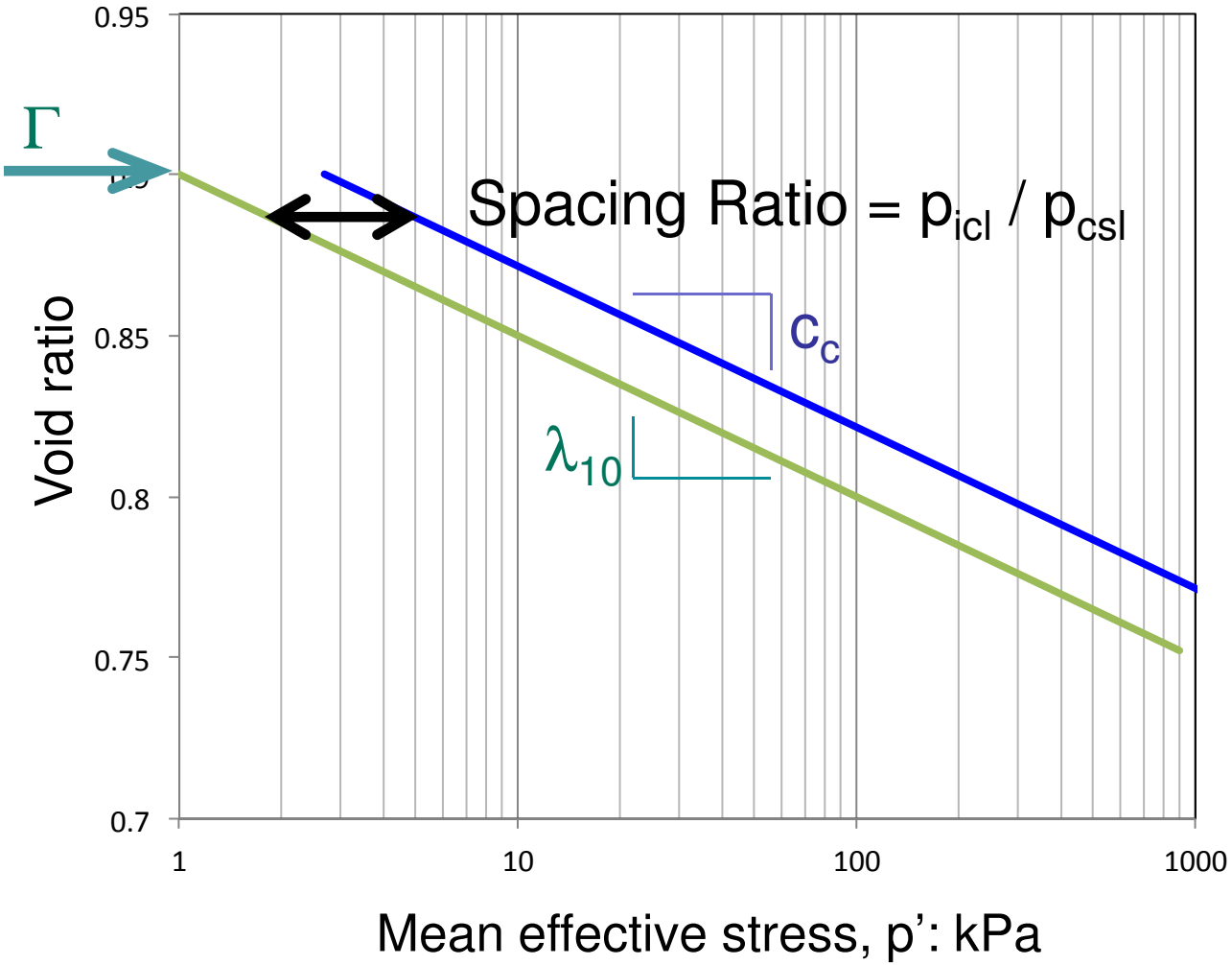
	A	B	C	D	E
1	**Soil properties…**				
2		*CSL parameters*			**Units**
3			**Γ =**	**0.817**	**@ 1 kPa**
4			**λ =**	**0.02**	**---**
5		*Plasticity*			
6			**Mtc =**	**1.28**	**---**
7			**N =**		**---**
8			**H_0 =**		**---**
9			**χ_{tc} =**		**---**
10		*Elasticity*			
11			**Gmax =**	**2000**	**MPa @ p0**
12			**G_exp =**	**1**	**---**
13			**ν =**	**0.2**	**---**
14			**κ =**	**0.005**	**---**
15	**Initial soil state…**				
16			**e0 =**	**0.711**	**---**
17			**p0 =**	**200**	**kPa**
18			**ψ0 =**		**---**



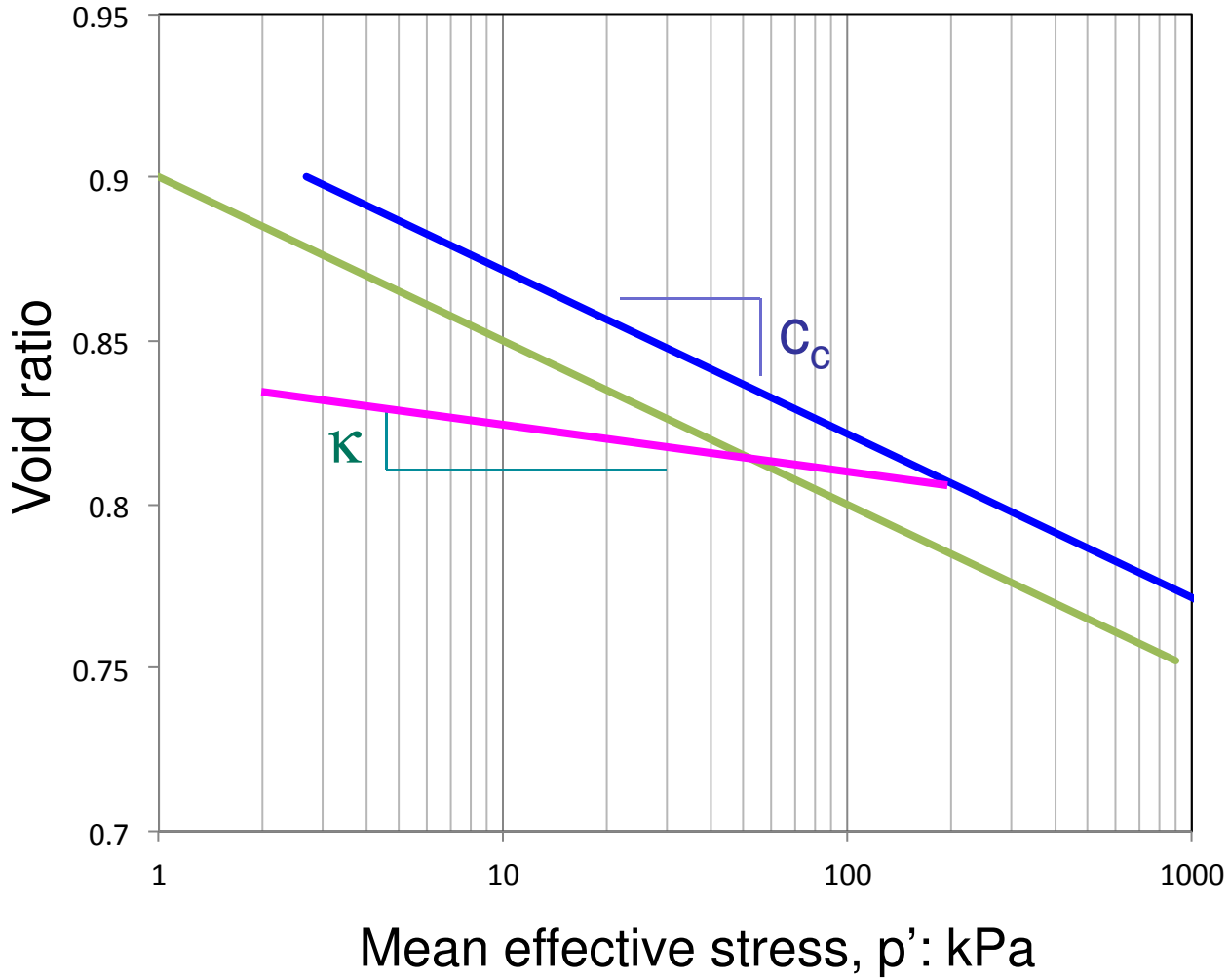
Inputs & Plots | Calcs | OCC closed form undrained | +

Normal View | Ready | Sum = 1.28

Isotropic compression



Elasticity


0.95
0.9
0.85
0.8
0.75
0.7
Void ratio
C_c
κ
1
10
100
1000
Mean effective stress, p': kPa

Log10 versus Ln

Used in theory

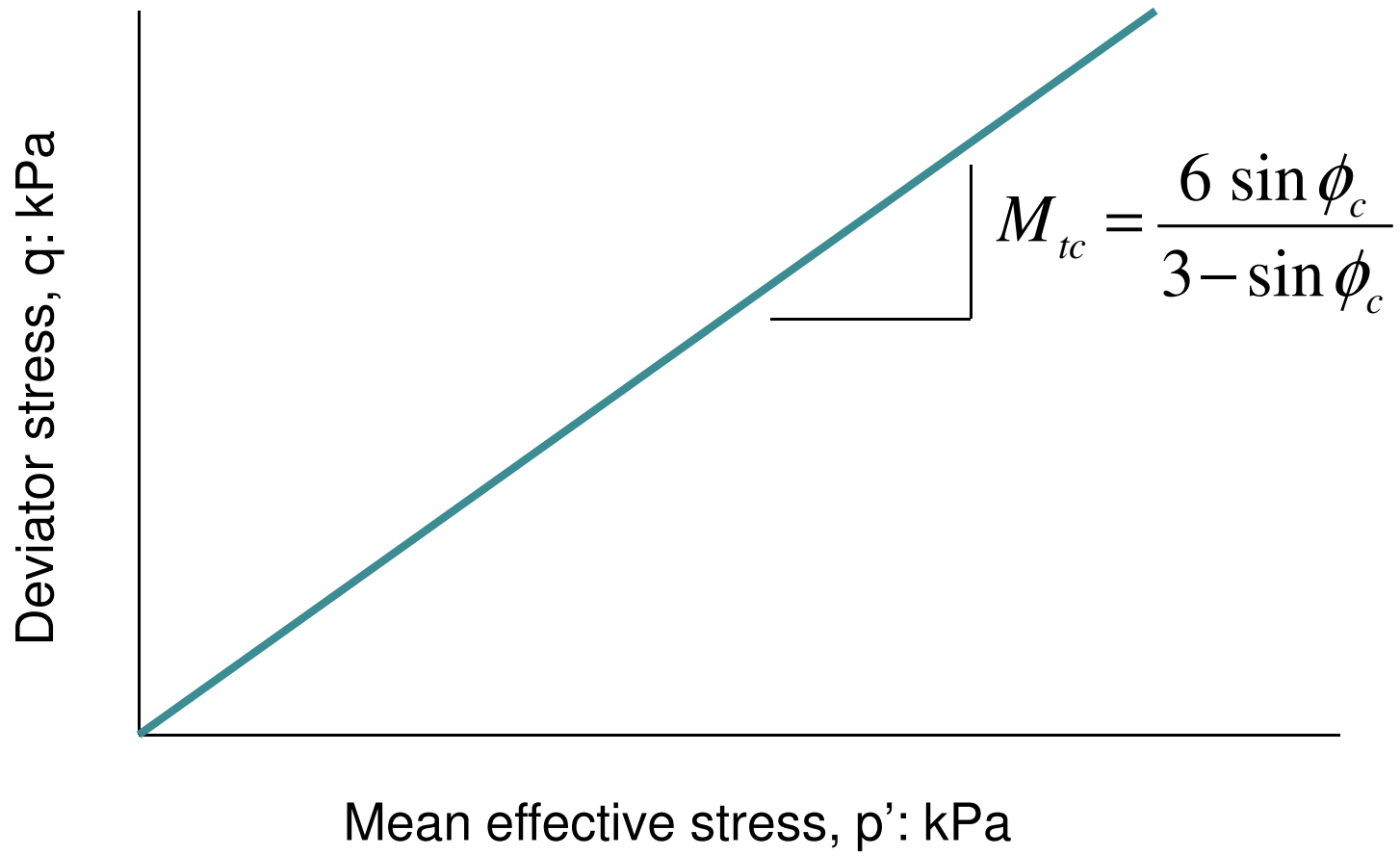
- CSL: $e_c = \Gamma \quad \lambda \ln(p')$
- Elasticity: $\Delta e = \kappa \, \Delta p' / p'$

What the lab reports

- CSL: $e_c = \Gamma \quad \lambda_{10} \log(p')$
- Elasticity: $\Delta e = c_r \, \Delta p' / p'$

$$\lambda = \lambda_{10} / 2.3 \qquad \kappa = c_r / 2.3$$

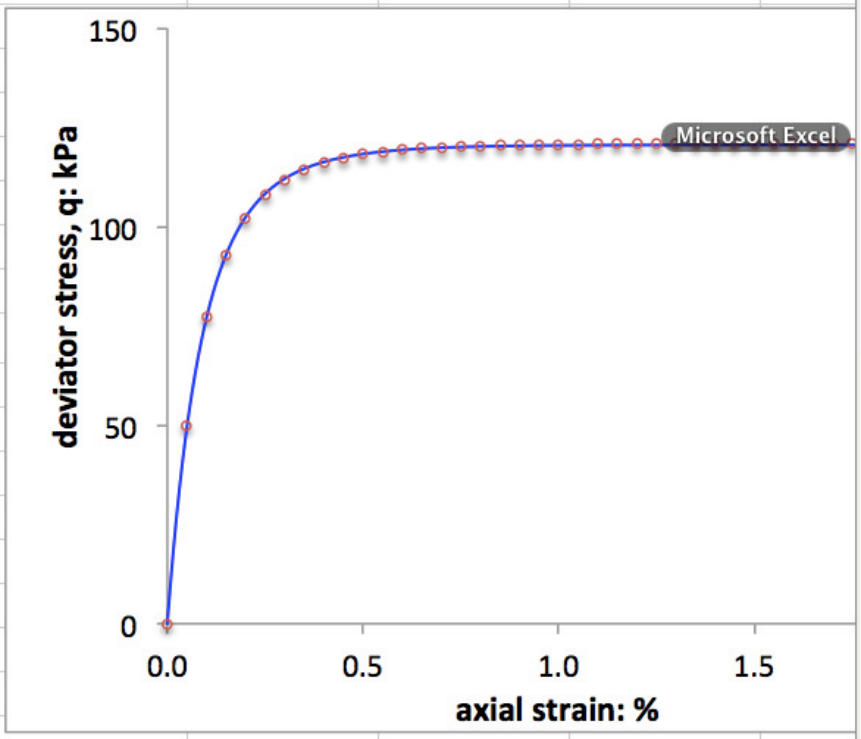
Critical Friction Ratio



Soil Property Inputs

CamClay_txlu.xlsx

	A	B	C	D	E
1	**Soil properties….**				
2		*CSL parameters*			**Units**
3			Γ =	0.817	@ 1 kPa
4			λ =	0.02	---
5		*Plasticity*			
6			Mtc =	1.28	---
7			N =		---
8			H_0 =		---
9			χ_{tc} =		---
10		*Elasticity*			
11			Gmax =	2000	MPa @ p0
12			G_exp =	1	---
13			ν =	0.2	---
14			κ =	0.005	---
15	**Initial soil state…**				
16			e0 =	0.711	---
17			p0 =	200	kPa
18			ψ0 =		---



Inputs & Plots | Calcs | OCC closed form undrained

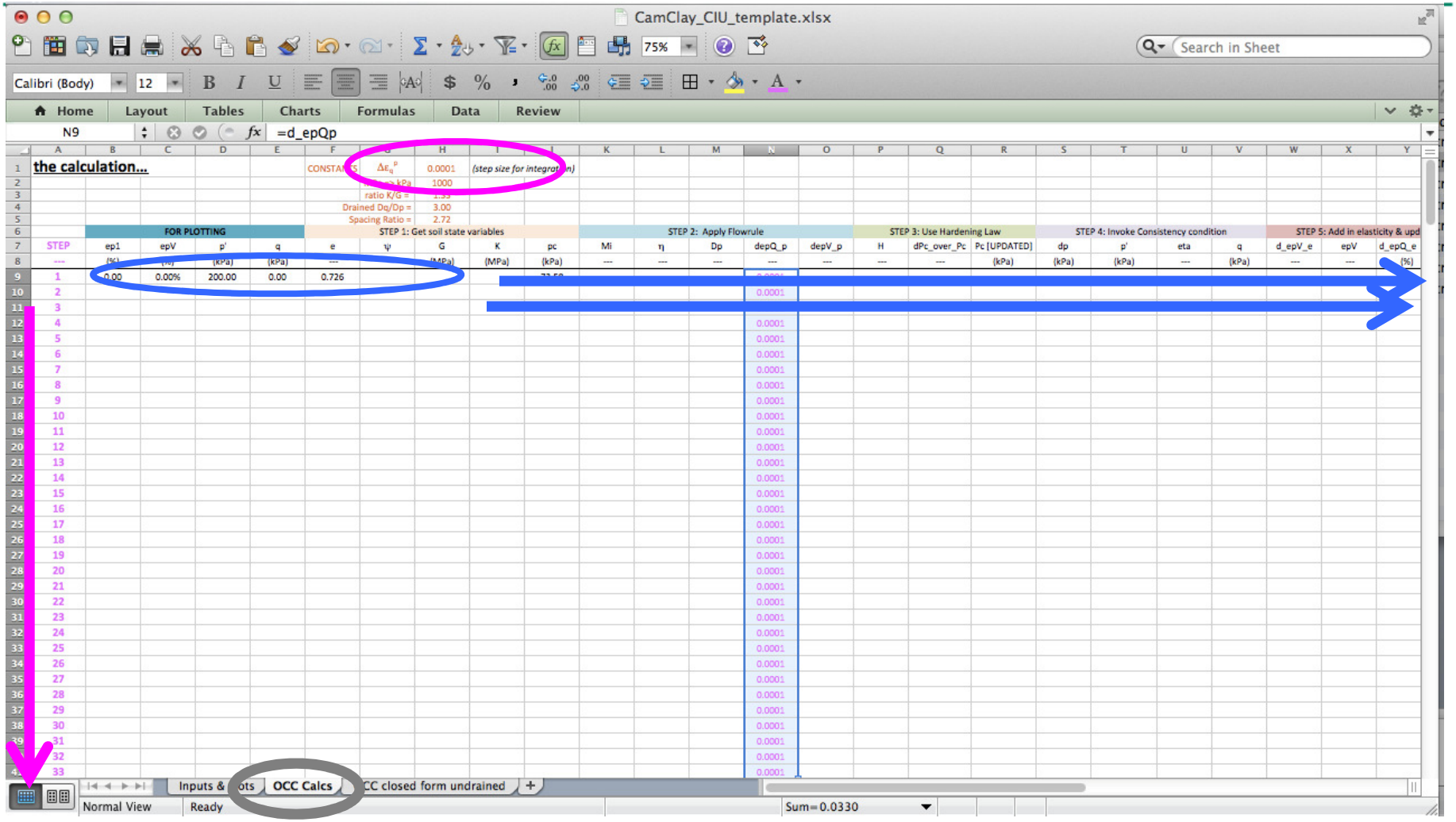
Normal View | Ready | Sum=1.28

Integration loop

Repeat until done

- $(\varepsilon_q^p)_{j+1} = (\varepsilon_q^p)_j + \Delta\varepsilon_q^p$ … step forward *plastic* strain step
- Get state variables … G, K, M_i depend on (e, σ)
- Apply flowrule => $\Delta\varepsilon_v^p$ … the other strain increment
- Harden yield surface ... yield surface changes size
- Find new stress state **… depends on stress path**
- Add elastic strain *incs*
- Update e

The Integration "Loop"



Euler's method