Developing confidence in critical state soil mechanics

4. Verifying numerical integration OCC

Mike Jefferies, PEng

Dr. Dawn Shuttle, PEng

January, 2015

Verification and Validation

- **Verification**: does the numerical model compute correctly ?
    - Compare numerical solution with a reference solution
    - Reference solution ideally closed form (but very few of them)
    - Cannot verify numerical methods by laboratory testing

- **Validation**: does the verified model have any relevance to engineering reality ?
    - Compare model with a body of laboratory test data…
    - Back-analysis of case-histories *(but rarely know enough…)*

Verification of OCC implementation

Critical State Soil Mechanics
Schofield and Wroth
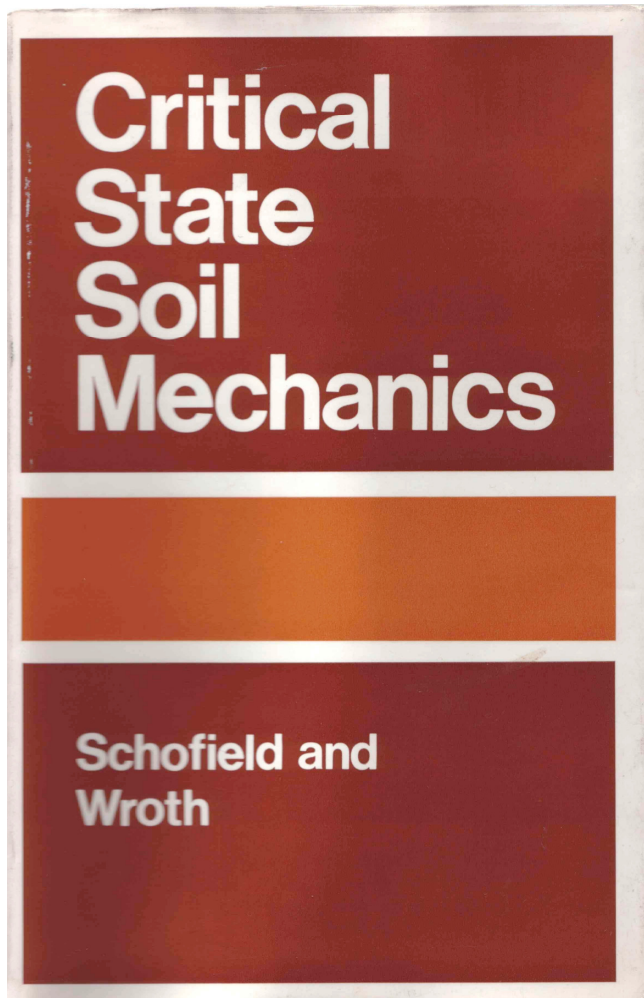
- http://www.geotechnique.info/
  - Chapter 6 in workshop info files

- OCC has two closed form solutions
  - Constant-p CID for NC soil
  - Undrained CIU for NC soil

- Use published solution without derivation

- Solution in Section 6.7
  - Implicit
  - Need to use 3 equations

OCC solution for CIU test on NC soil

Spreadsheet: CamClay_txlu_setup.xlsx — sheet "OCC closed form undrained"

Cell B16: ep1:%

	A	B	C	D	E	F
1	closed form solution of an undrained triaxial test from isotropic conditions					
2	taken from schofield & wroth p146-149					
3	**Initial conditions**					
4	p0 =	200				
5	e0 =	0.556				
6	**Properties**					
7	M =	1.28				
8	λ =	0.02				
9	κ =	0.005				
10	derived constants for this test					
11	Λ =	0.75	= 1 − κ/λ			
12	pu =	94.47331	just above eqn 6.28 in S&W			
13	v0 =	1.556				
14	calculations stepping forward by strain					
15			eqn 6.30		eqn 6.31	
16	epQ	ep1:%	ln(p/pu)	p: kPa	eta/M	q: kPa
17	0	0.00	0.75	200	0	0
18	0.0005	0.05	0.572702589	167.5061	0.233222	50.00452
19	0.001	0.10	0.437317674	146.2964	0.412051	77.1604
20	0.0015	0.15	0.333937285	131.9278	0.549173	92.73753
21	0.002	0.20	0.254995664	121.9137	0.654316	102.1056
22	0.0025	0.25	0.194715569	114.7818	0.734937	107.9774
23	0.003	0.30	0.148685481	109.6181	0.796755	111.7937
24	0.0035	0.35	0.113536746	105.8321	0.844156	114.3537
25	0.004	0.40	0.086697051	103.0294	0.880502	116.1186
26	0.0045	0.45	0.066202168	100.9393	0.908372	117.3637
27	0.005	0.50	0.0505	99.37192	0.92 741	118.2594

Tabs: Inputs & Plots | Calcs | OCC closed form undrained

Numerical using Euler integration
Closed form S&W Sect 6.7