More tests upon the GHS model

Construction of an embankment

Introduction

The test is based on PLAXIS 2D AE Tutorial Chapter 4. The idea is to replace the clay layer modelled by soft clay model by the GHS model and HSsmall model.

The following outcomes can be compared:

- The performance of the GHS model in consolidation analysis, with and without drainage;
- The safety analysis;
- The combination with updated mesh;
- New stress dependent stiffness formulation for soil near the toe of the embankment;

Input parameters

Identification		clay_HSsmall
Material model		HS small
Drainage type		Undrained (A)
γ_unsat	kN/m³	15
γ_sat	kN/m³	18
Dilatancy cut-off		No
e_init		1
E_50^ref	kN/m²	4,84E+03
E_oed^ref	kN/m²	2,07E+03
E_ur^ref	kN/m²	2,86E+04
power (m)		0,7
Use alternatives		No
C_c		2,22E-01
C_s		1,53E-02
e_init		1
c_ref	kN/m²	1
ϕ (phi)	°	25
ψ (psi)	°	0
γ_0.7		1,50E-04
G_0^ref	kN/m²	2,80E+04
Set to default values		No
ν_ur		0,15
p_ref	kN/m²	100
K_0^nc		0,5774

c_inc	kN/m²/m	0
y_ref	m	0
R_f		0,9
Tension cut-off		Yes
Tensile strength	kN/m²	0
Undrained behaviour		Standard
Skempton-B		0,989
v_u		0,495
K_w,ref / n	kN/m²	1,22E+06
Failure criterion		Mohr-Coulomb
Strength		Rigid
R_inter		1
Consider gap closure		Yes
δ_inter		0
K_0 determination		Manual
K_0,x		0,5
OCR		1
POP	kN/m²	0
Data set		USDA
Model		Van Genuchten
Type		Clay
< 2 µm	%	70
2 µm - 50 µm	%	1,30E+01
50 µm - 2 mm	%	17
Set to default values		Yes
k_x	m/day	0,04752
k_y	m/day	0,04752
#NAME?	m	1,00E+04
e_init		1
c_k		0,2

Figure 1 Input parameters for the HSsmall model

Identification		clay_GHS
Material model		User-defined
Drainage type		Undrained (A)
γ_unsat	kN/m³	15
γ_sat	kN/m³	18
Dilatancy cut-off		No
e_init		1
DLL file		ghs.dll
Model in DLL		HSSmall
E_50	kN/m²	4843

E_oed	kN/m²	2071
E_ur	kN/m²	2,86E+04
power (m)		0,7
ϑ	°	25
ψ	°	0
c	kN/m²	1
γ_0.7		1,50E-04
G_0^ref	kN/m²	2,80E+04
e_init		1
v_ur		0,15
P_ref	kN/m²	100
R_f		0,9
σ_t	kN/m²	0
failure (0:MC or 1:M-N)		0
OCR		1
POP		0
k_0		0
k_0^nc		0,5774
v_u		0
M (internal)		0
K_s/K_c (internal)		0
G_50^ref (internal)		0
Stress Dependent Stiffness		2
Strain Dependent Stiffness		1
Plasticity Model		4
Stress Dependency Formula		0
Strength		Rigid
R_inter		1
Consider gap closure		Yes
δ_inter		0
E_oed^ref	kN/m²	1
c_ref	kN/m²	1
ϕ (phi)	°	25
ψ (psi)	°	0
UD-Power		0
UD-P^ref	kN/m²	100
K_0 determination		Manual
K_0,x		0,5
Data set		USDA
Model		Van Genuchten
Type		Clay

< 2 µm	%	70
2 µm - 50 µm	%	13
50 µm - 2 mm	%	17
Set to default values		Yes
k_x	m/day	0,04752
k_y	m/day	0,04752
#NAME?	m	1,00E+04
e_init		1
c_k		0,2

Figure 2 Input parameters for the GHS model

Comparisons

Deformation due to consolidation

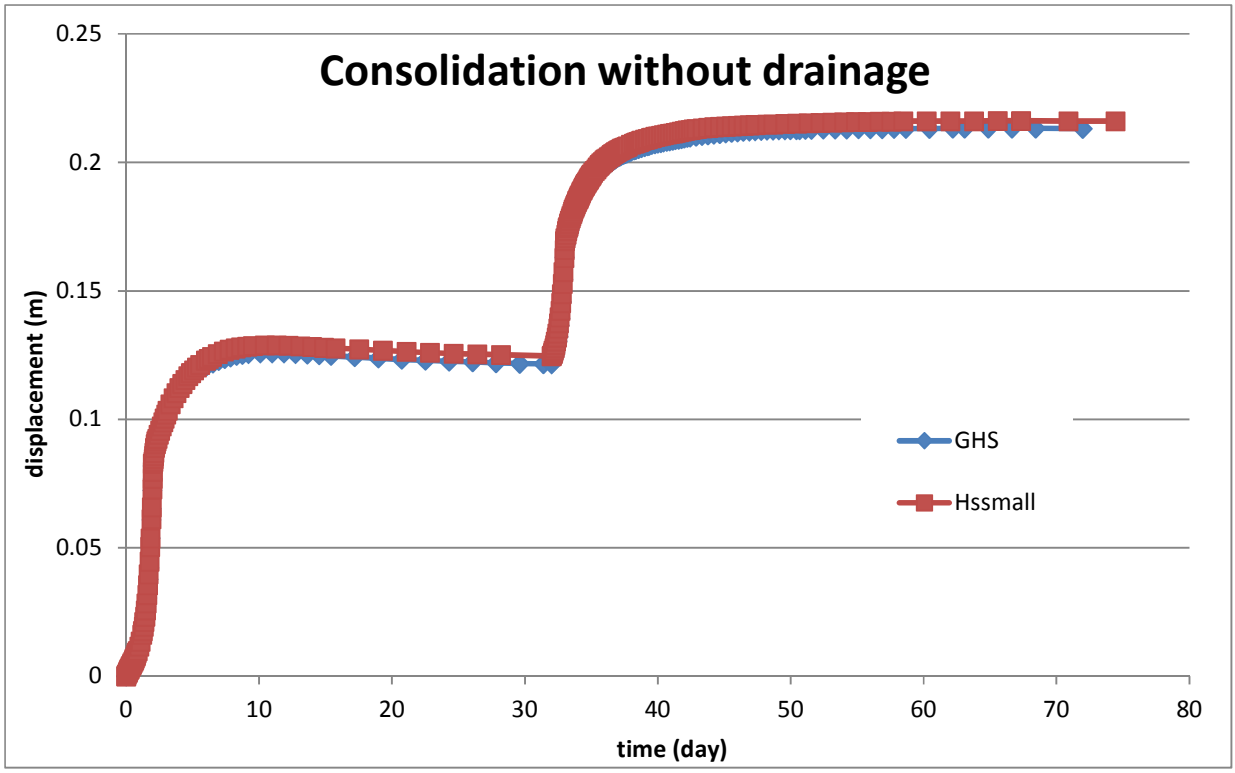

Figure 3 Consolidate to the min Pexcess without drainage

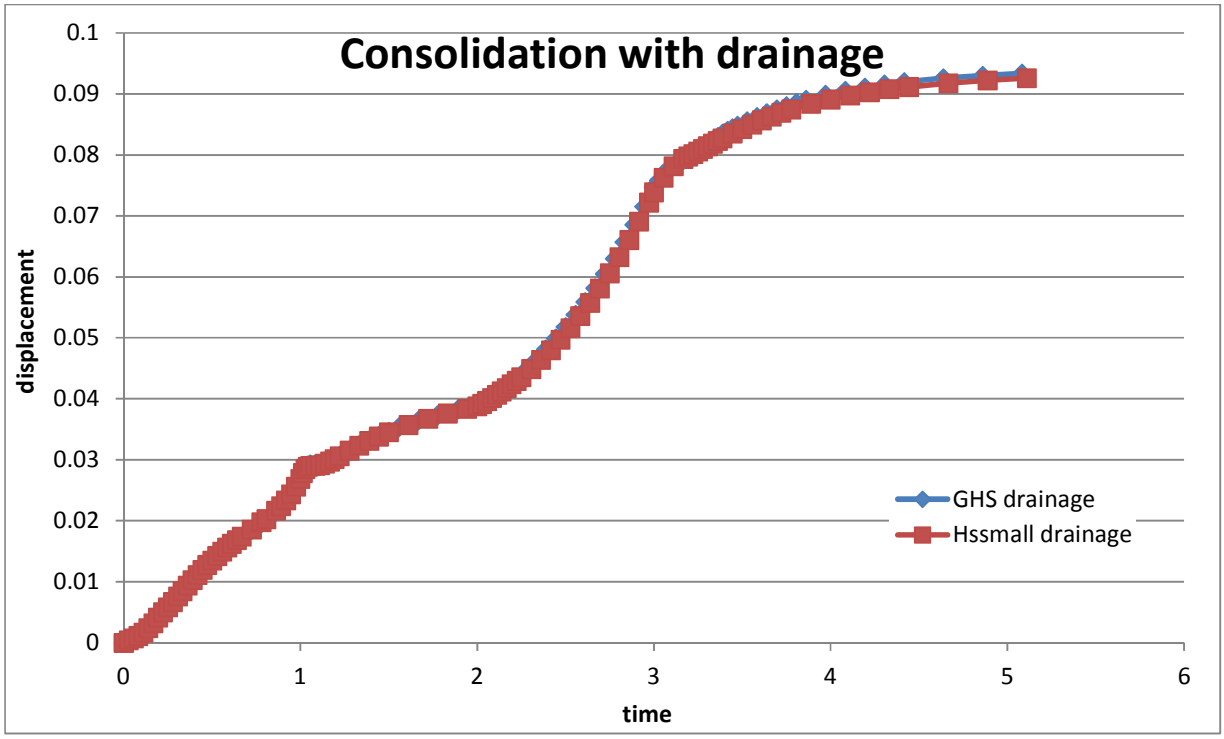

Figure 4 Consolidate to the min Pexcess with drainage

Excess pore pressure

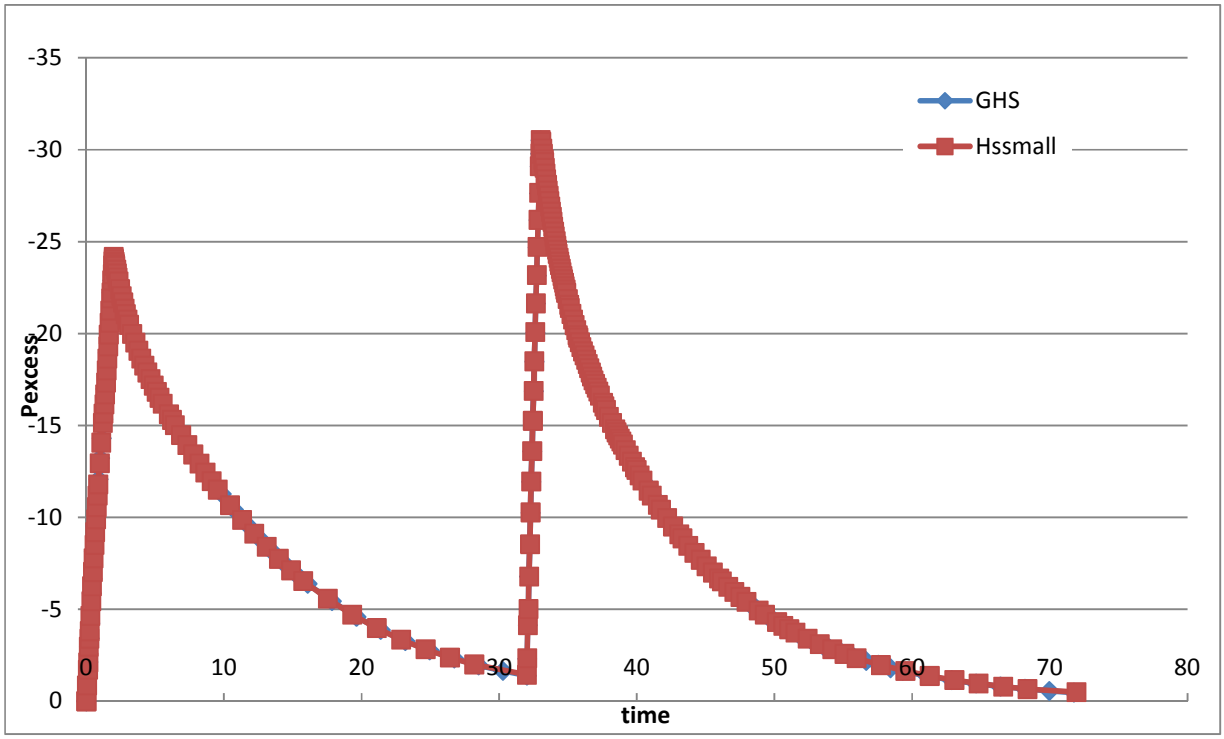

Figure 5 Excess pore pressure varies with time

Factor of safety

SF immediately after 2nd layer		SF at the end		SF immediately after 1st layer	
GHS	1,118	GHS	1,471	GHS	1,035
Hssmall	1,109	Hssmall	1,472	Hssmall	1,026

Table 1 Factor of safety in various phases

Updated mesh

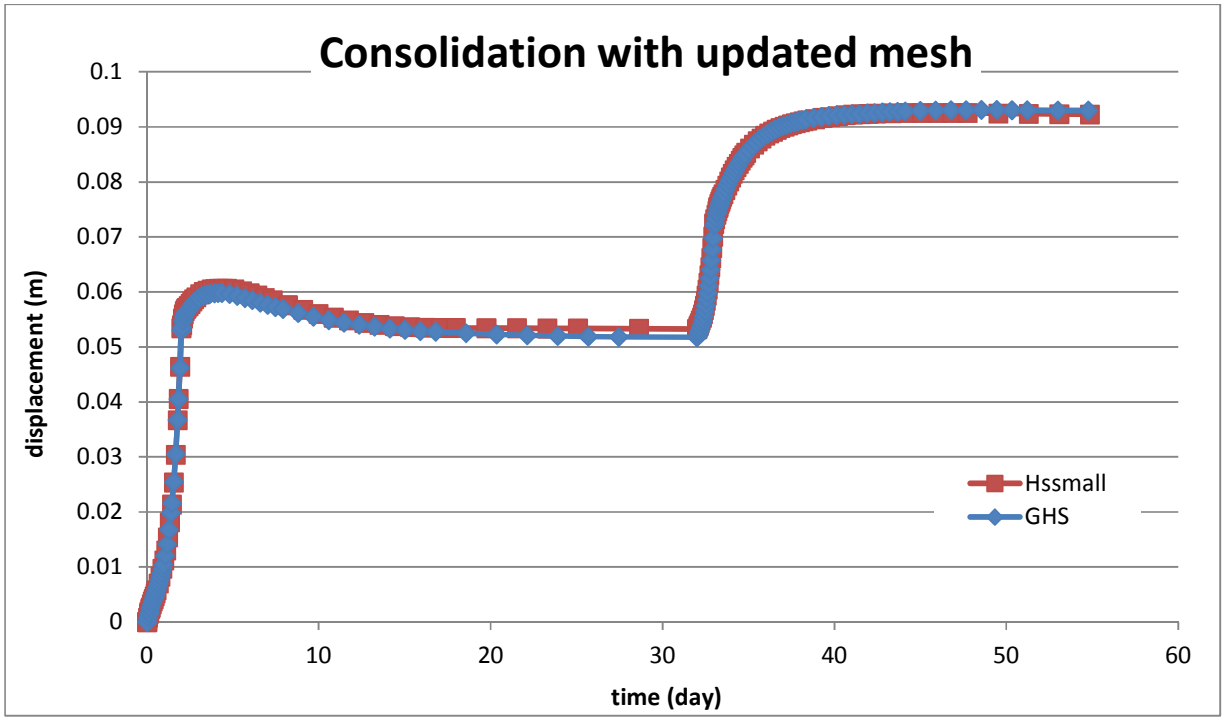

Figure 6 Comparison of GHS and HSsmall model for consolidation with updated mesh

Different stress dependent stiffness

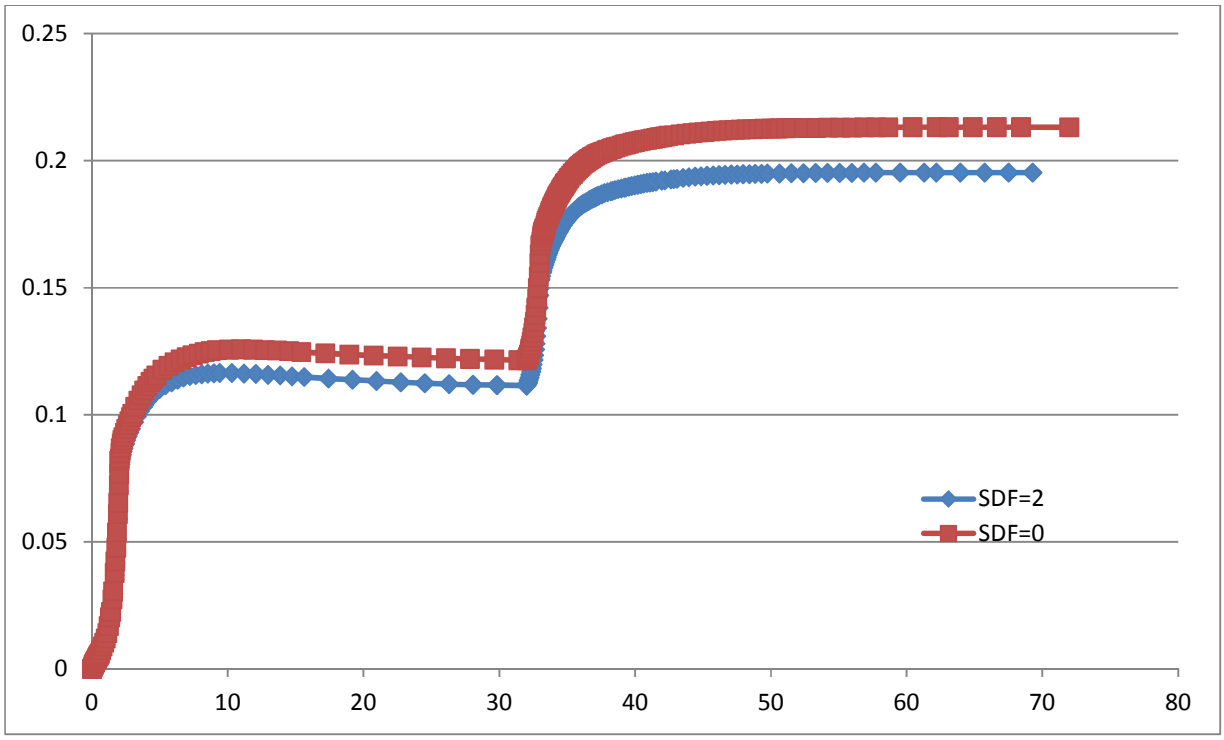

Figure 7 SDF=stress dependent stiffness formula