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Anexos

Anexo 1 – Modelo FLAC para camadas de depósito de solo não-linear

```

config dynamic
;-----
;Geração de malha e propriedades do modelo
;-----
grid 1,41
model elastic
gen 0.0,0.0 0.0,41.0 1.0,41.0 1.0,0.0
gen 0.0,0.0 0.0,41.36 1.0,41.36 1.0,0.0
group 'User:botafora3' j 1 2
model elastic group 'User:botafora3'
prop density=2449.0 bulk=7.18593E8 shear=3.70525E8 group 'User:botafora3'
group 'User:botafora2' j 3 4
model elastic group 'User:botafora2'
prop density=2449.0 bulk=7.01284E8 shear=3.616E8 group 'User:botafora2'
group 'User:botafora1' j 5 7
model elastic group 'User:botafora1'
prop density=2449.0 bulk=6.83537E8 shear=3.52449E8 group 'User:botafora1'
group 'User:rejeito6' j 8 10
model elastic group 'User:rejeito6'
prop density=2041.0 bulk=4.99071E8 shear=2.3034E8 group 'User:rejeito6'
group 'User:rejeito5' j 11 13
model elastic group 'User:rejeito5'
prop density=2041.0 bulk=4.83472E8 shear=2.23141E8 group 'User:rejeito5'
group 'User:rejeito4' j 14 16
model elastic group 'User:rejeito4'
prop density=2041.0 bulk=4.67354E8 shear=2.15702E8 group 'User:rejeito4'
group 'User:rejeito3' j 17 19
model elastic group 'User:rejeito3'
prop density=2041.0 bulk=4.50659E8 shear=2.07996E8 group 'User:rejeito3'
group 'User:rejeito2' j 20 22
model elastic group 'User:rejeito2'
prop density=2041.0 bulk=4.33322E8 shear=1.99995E8 group 'User:rejeito2'
group 'User:rejeito1' j 23 25
model elastic group 'User:rejeito1'
prop density=2041.0 bulk=4.15261E8 shear=1.91659E8 group 'User:rejeito1'
group 'User:fundação3' j 26 27
model elastic group 'User:fundação3'
prop density=1938.0 bulk=3.8698E8 shear=1.78606E8 group 'User:fundação3'
group 'User:fundação2' j 28 29
model elastic group 'User:fundação2'
prop density=1938.0 bulk=3.61554E8 shear=1.66871E8 group 'User:fundação2'
group 'User:fundação1' j 30 31
model elastic group 'User:fundação1'
prop density=1938.0 bulk=3.34199E8 shear=1.54246E8 group 'User:fundação1'
group 'User:aterro5' j 32 33
model elastic group 'User:aterro5'

```

```

prop density=1887.0 bulk=2.79029E8 shear=1.28783E8 group 'User:aterro5'
group 'User:aterro4' j 34 35
model elastic group 'User:aterro4'
prop density=1887.0 bulk=2.49572E8 shear=1.15187E8 group 'User:aterro4'
group 'User:aterro3' j 36 37
model elastic group 'User:aterro3'
prop density=1887.0 bulk=2.16135E8 shear=9.97547E7 group 'User:aterro3'
group 'User:aterro2' j 38 39
model elastic group 'User:aterro2'
prop density=1887.0 bulk=1.76474E8 shear=8.14494E7 group 'User:aterro2'
group 'User:aterro1' j 40 41
model elastic group 'User:aterro1'
prop density=1887.0 bulk=1.24786E8 shear=5.75934E7 group 'User:aterro1'
;
;Função FISH para calcular deformação cisalhante em zona 37
;
def shrstr37
    shrstr37=(xdisp(1,37)-xdisp(1,36))/(y(1,37)-y(1,36))
end
;
;Condições de contorno
;
fix x y j 1
fix y
;
;Historias
;
history 1 xaccel i=1, j=30
history 2 xaccel i=2, j=30
history 3 vsxy i=1, j=37
history 4 shrstr37
history 5 dytime
;
;Aplicação de aceleração
;
hist 100 read mqroca.his
apply xacc 1 hist 100 j=1
apply yacc 0.0 j=1; comando que prevem rocking
ini dy_damp hyst default -3.325 0.823
set dynamic on
set step 1000000
solve dytime 163
;
;Resultados
;
his write 1 vs 5 tab 6
his write 3 vs 4 tab 8

```

Anexo 2: Análise dinâmica de aterro reforçado com geossintéticos usando FLAC v.5

```

;-----
;Estado1.sav
;-----

config dynamic
grid 35,28
gen (0.0,0.0) (0.0,2.0) (18.0,2.0) (18.0,0.0) ratio 0.95,1.0 i 1 16 j 1 3
gen (0.0,2.0) (0.0,12.4) (15.4,12.4) (18.0,2.0) ratio 0.95,1.0 i 1 16 j 3 29
gen (18.0,0.0) (18.0,2.0) (28.0,2.0) (28.0,0.0) i 16 31 j 1 3
gen (18.0,2.0) (15.4,12.4) (25.4,12.4) (28.0,2.0) i 16 31 j 3 29
gen (28.0,0.0) (28.0,2.0) (33.0,2.0) (33.0,0.0) ratio 1.05,1.0 i 31 36 j 1 3
gen (28.0,2.0) (25.4,12.4) (33.0,12.4) (33.0,2.0) ratio 1.05,1.0 i 31 36 j 3 29
model elastic i=1,35 j=1,28
model null i 31 35 j 3 28
group 'null' i 31 35 j 3 28
group delete 'null'
struct node 1 grid 16,3
struct node 2 grid 31,3
struct node 3 grid 16,6
struct node 4 grid 31,6
struct node 5 grid 16,9
struct node 6 grid 31,9
struct node 7 grid 16,12
struct node 8 grid 31,12
struct node 9 grid 16,15
struct node 10 grid 31,15
struct node 11 grid 16,18
struct node 12 grid 31,18
struct node 13 grid 16,21
struct node 14 grid 31,21
struct node 15 grid 16,24
struct node 16 grid 31,24
struct node 17 grid 16,27
struct node 18 grid 31,27
struct cable begin node 1 end node 2 seg 16 prop 2001
struct cable begin node 3 end node 4 seg 16 prop 2001
struct cable begin node 5 end node 6 seg 16 prop 2001

```

```

struct cable begin node 7 end node 8 seg 16 prop 2002
struct cable begin node 9 end node 10 seg 16 prop 2002
struct cable begin node 11 end node 12 seg 16 prop 2002
struct cable begin node 13 end node 14 seg 16 prop 2002
struct cable begin node 15 end node 16 seg 16 prop 2002
struct cable begin node 17 end node 18 seg 16 prop 2002
struct prop 2001
struct prop 2002
struct prop 2001 density 1200.0 e 191000000 area 0.0050 kbond 1.0E10 yield 200000.0
sfriction 30.0 perimeter 2.000
struct prop 2002 density 1200.0 e 151000000 area 0.0050 kbond 1.0E10 yield 150000.0
sfriction 30.0 perimeter 2.000
group 'A:fundação' j 1 2
model elastic group 'A:fundação'
prop density=1938.0 bulk=1.78642E9 shear=8.245E8 group 'A:fundação'
group 'c:nãoescoamento' i 1 2 j 3 28
model mohr group 'c:nãoescoamento'
prop density=1887.0 cohesion=8E12 friction=30.0 dilation=0.0 tension=1e10 group
'c:nãoescoamento'
group 'b:aterro' i 3 28 j 3 28
model mohr group 'b:aterro'
prop density=1887.0 cohesion=1e10 friction=30.0 dilation=0.0 tension=1e10 group
'b:aterro'
group 'b:paramento' i 29 30 j 3 28
model mohr group 'b:paramento'
prop density=1887.0 cohesion=1e10 friction=30.0 dilation=0.0 tension=1e10 group
'b:paramento'
def install
loop i (1,30)
loop j (3,jzones)
yc=(y(i,j)+y(i+1,j)+y(i,j+1)+y(i+1,j+1))/4.0
zz= y(3,jgp)-yc
syy_mod= p_e*zz
sxx_mod= syy_mod*p_ratio/(1.00-p_ratio)
s_m=(syy_mod+(2*sxx_mod))/3
shear_mod(i,j)=218.8*k_max*(s_m^0.5)*1000
bulk_mod(i,j)=2*shear_mod(i,j)*(1+p_ratio)/(3*(1-2*p_ratio))
end_loop
end_loop
end

```

```

set p_ratio=0.3 P_e=18.50 k_max=55
install
fix x y j 1
fix x i 1
fix x i 36 j 1 3
set gravity=9.8
set dyn=off
history 999 unbalanced
solve
;-----
;Estado2.sav
;-----
group 'A:fundação' j 1 2
model elastic group 'A:fundação'
prop density=1938.0 bulk=1.78642E9 shear=8.245E8 group 'A:fundação'
group 'c:nãoescoamento' i 1 2 j 3 28
model mohr group 'c:nãoescoamento'
prop density=1887.0 cohesion=8E12 friction=30.0 dilation=0.0 tension=00 group
'c:nãoescoamento'
group 'b:aterro' i 3 28 j 3 28
model mohr group 'b:aterro'
prop density=1887.0 cohesion=0 friction=30.0 dilation=0.0 tension=0 group 'b:aterro'
group 'b:paramento' i 29 30 j 3 28
model mohr group 'b:paramento'
prop density=1887.0 cohesion=30000 friction=30.0 dilation=0.0 tension=0 group
'b:paramento'
def change_shear
  loop i (1,30)
    loop j (3,jzones)
      s_m=abs(sxx(i,j)+syy(i,j)+szz(i,j))/3
      shear_mod(i,j)=6919.5*k_max*(s_m^0.5)
      bulk_mod(i,j)=2*shear_mod(i,j)*(1+p_ratio)/(3*(1-2*p_ratio))
    endloop
  endloop
end
set p_ratio=0.3 k_max=55
change_shear
solve

```

```

;-----
;tratasismo.sav
;-----

set dyn on
set=large
his 1 read mqs.his
his write 1 table 1
set echo off
def tab_ind
fft_in=1
fft_out=2
end
tab_ind
call fft.fis
fftransform
call int.fis
set int_in 2 int_out 3
integrate
ret
;filtrao a-t
call filter.fis
set fc=7.30
set filter_in=1
set filter_out=4
filter
ret
set fft_in=4
set fft_out=9
fftransform
ret
;
call int.fis
set int_in 4 int_out 5
integrate
ret
call int.fis
set int_in 5 int_out 6
integrate
ret

```

```

;correção de linha de base (Tabela7)
set echo off
call baseline.fis
set itab_unc=5 itab_corr=17 drift=-7.085e-01 ttime=40.05
set npnts=1336 itab_cvel=7
baseline
ret
call int.fis
set int_in 7
set int_out 8
integrate
;-----
;Não_amortecido.sav
;-----
apply ffield
apply sxy -1453684 hist table 7 from 1,1 to 36,1
apply xquiet yquiet from 1,1 to 36,1
set dyn on
ini xvel=0 yvel=0
ini xdis=0 ydis=0
history 1 xvel i=15, j=15
history 2 dytime
his nstep 150
set step 10000000
solve dytime 40.05
his write 1 vs 2 table 10 ; frequencia central
set fft_in=10
set fft_out=11
fftransform
;-----
;Amort_Rayleigh.sav
;-----
set dy_damping rayleigh= 0.075 1.048
apply ffield
apply sxy -1453684 hist table 7 from 1,1 to 36,1
apply xquiet yquiet from 1,1 to 36,1
set dyn on
ini xvel=0 yvel=0
ini xdis=0 ydis=0
history 2 xdisp i=31, j=29

```

```

history 3 xvel i=31, j=29
history 4 dytime
his nstep 150
set step 10000000
solve dytime 40.05
;-----
;Amort_histeretico.sav
;-----
initial dy_damp hyst default -3.325 0.823
set dy_damping rayleigh=0.005 1.048 stiffness
apply ffield
apply sxy -1453684 hist table 7 from 1,1 to 36,1
apply xquiet yquiet from 1,1 to 36,1
set dyn on
ini xvel=0 yvel=0
ini xdis=0 ydis=0
history 2 xdisp i=31, j=29
history 3 xvel i=31, j=29
history 4 dytime
his nstep 300
set step 10000000
solve dytime 40.05
;-----
;Amort_local
;-----
set dy_damp=local 0.23562
apply ffield
apply sxy -1453684 hist table 7 from 1,1 to 36,1
apply xquiet yquiet from 1,1 to 36,1
set dyn on
ini xvel=0 yvel=0
ini xdis=0 ydis=0
history 2 xdisp i=31, j=29
history 3 xvel i=31, j=29
history 4 dytime
his nstep 300
set step 10000000
solve dytime 40.05

```