
Order DEFI_SOL_EQUI

1 Goal

To characterize the variation of the mechanical characteristics of horizons soil laminated during an earthquake starting from their level of shearing strain.

For that, one determines by an iterative procedure Python for each one of these soil horizons of the readjusted linear characteristics equivalent starting from the curves of reduction of the modulus of rigidity and hysteretic increase in damping according to the shearing strain.

This procedure is generally based on a model of column of ground laminated 2D in plane deformations, with a grid by horizontal layers, subjected to a horizontal acceleration of training with condition of periodicity between the left face and the right face and condition absorbing at the base.

The order DEFI_SOL_EQUI allows to produce a table containing of the necessary information to the description of a file of ground for software MISS3D.

Data entered by the order DEFI_SOL_EQUI are:

- the description of the characteristics of materials to the nonlinear behaviors grouped by zones of layers,
- the geometrical description of the successive elementary layers, that of the characteristics of materials the component and the assignments with these successive layers of preceding nonlinear materials,
- digital parameters of the iterative process of calculation.

The table of ground thus produced will be provided in argument of CALC_MISS [U7.03.12].

One also provides as a result the transitory evolutions and the spectra of accelerations obtained to the bottom of each soil horizon.

2 Syntax

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tabsol [table] = DEFI_SOL_EQUI (

    ♦ FONC_SIGNAL = foncs, [function]
    ♦ LIEU_SIGNAL = / 'LEVELLING', [DEFECT]
                  / 'CHAMP_LIBRE',

    ♦ GRID = my, [grid]
    ♦ GROUP_MA_COL = gmco, [grma]
    ♦ GROUP_MA_DROITE = gmdr, [grma]
    ♦ GROUP_MA_GAUCHE = gmga, [grma]
    ♦ GROUP_MA_SUBSTR = gmdr, [grma]
    ♦ SURFING = / 'NOT', [DEFECT]
              / 'YES',

    # If SURF=' NON' many enfonces layers:
    ♦ NIVE_COUCH_ENFO = ncoue, [I]
    ♦ NB_RECEPTEUR = / 2, [DEFECT]
                  / 4,

    ♦ CORR_AMOR = / 'NOT', [DEFECT]
                 / 'YES',

    ♦ COEF_VARI_MATE = / coevm, [R]
                     / 1.0, [DEFECT]
    ♦ COEF_AMPL_ACCE = / coeaa, [R]
                     / 1.0, [DEFECT]
    ♦ COEF_GAMMA = / coega, [R]
                  0.65, [DEFECT]
    ♦ NMAX_ITER = / nmaxi, [I]
                 / 10, [DEFECT]
    ♦ RESI_RELA = / to resir, [R]
                 / 0.05, [DEFECT]
    ♦ FREQ_COUP = freqc, [R]
    ♦ LIST_FREQ = listfreq, [listR8]

    ♦ / ♦ MATERIAL = _F ( ♦ GAMMA = lgamma, [l_R]
                        ♦ G_GMAX = lggma, [l_R]
                        ♦ D = lisd, [l_R]
                        ),
        ♦ SLEEP = _F ( ♦ THICK = thick, [R]
                      ♦ E = Young, [R]
                      ♦ NAKED = naked, [R]
                      ♦ RHO = rho, [R]
                      ♦ AMOR_HYST = beta, [R]
                      ♦ NUME_MATE = numat, [I]
                      ♦ GROUP_MA = gmaco, [grma]
                      ),

    / ♦ TABLE_MATER_ELAS = tmela, [table]
      ♦ TABLE_GEQUI_GMAX = tggma, [table]
      ♦ TABLE_AMOR_EQUI = tameq, [table]

    # Output units
    ♦ UNITE_TABLE_RESU = utres, [I]
    ♦ UNITE_RESU_TRAN = / uretr, [I]
                      / 40, [DEFECT]
    ♦ UNITE_RESU_SPEC = / uresp, [I]
                      / 55, [DEFECT]

    ♦ INFORMATION = / 1,
[DEFECT]
                  / 2,
    ♦ TITLE = title, [l_Kn]

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Code_Aster

Version
default

Titre : *Opérateur DEFI_SOL_EQUI*
Responsable : *DEVESA Georges*

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ae6111c5654c

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3 Operands

3.1 Operand FONC_SIGNAL

◆ FONC_SIGNAL = foncs

Allows `G_MAX = lggma` to define a temporal function defining the signal of horizontal acceleration of training, imposed on the model of column representative of the stratification of ground, from which one characterizes the variation of the mechanical characteristics of horizons soil laminated according to their level of shearing strain.

3.2 Operand LIEU_SIGNAL

◆ LIEU_SIGNAL = / 'LEVELLING', [DEFECT]
/ 'CHAMP_LIBRE',

Indicate the place of imposition of the signal compared to the column of ground:

LIEU_SIGNAL = 'LEVELLING' : signal imposed on the base of the column (with the levelling rock).

LIEU_SIGNAL = 'CHAMP_LIBRE' : signal imposed at the top of the column (in free field).

3.3 Operand FREQ_COUP

◆ FREQ_COUP = freqc

Cut-off frequency allowing to filter the entry signal. By default, one takes a maximum value corresponding to half of the reverse of the step of time of the entry signal.

3.4 Operand GRID

◆ GRID = my

Allows to define the name of the concept of the total surface grid of the column representative of the stratification of ground. It will be affected there a model of plane deformations ('D_PLAN').

3.5 Operand GROUP_MA_COL

◆ GROUP_MA_COL = gmco

Allows to define in the preceding grid the name of the surface group of meshes including the whole of the column representative of the stratification of ground.

3.6 Operands GROUP_MA_DROITE/GROUP_MA_GAUCHE

◆ GROUP_MA_DROITE = gmda

◆ GROUP_MA_GAUCHE = gmga

Allow respectively to define in the preceding grid the names of the linear groups of meshes to which will be affected a relation of periodicity between the flat rim and the left edge of the column representative of the stratification of ground.

3.7 Operand GROUP_MA_SUBSTR

◆ GROUP_MA_SUBSTR = gmdr

Allows to define in the preceding grid the linear name of the groups of meshes to which a modeling of absorbing border will be affected.

3.8 Operand SURFING

◇ SURFING = / 'NOT', [DEFECT]
/ 'YES',

Indicate if one wants or not to have certain layers of the ground modelled in the column above an inserted foundation, which one finds in the table of ground usable by MISS3D:

SURFING = 'YES' : shallow foundation compared to the soil horizons.
SURFING = 'NOT' : depression of the foundation in the ground.

3.9 Operand NIVE_COUCH_ENFO

◇ NIVE_COUCH_ENFO = ncoue

If SURFING = 'NOT', and that this operand is indicated, the number of soil horizons gives above the inserted foundation. If the operand is not indicated, one takes by default all them soil horizons above substratum.

3.10 Operand NB_RECEPTEUR

◇ NB_RECEPTEUR = / 2, [DEFECT]
/ 4,

Allows to define the number of receivers per layer of element inserted in the laminated ground: also corresponds to the number of underlayers generated for each layer of element inserted in the table of ground produced.

3.11 Keyword MATERIAL

◆ MATERIAL = _F (

Keyword factor répétable allowing the description of the characteristics of families of materials nonlinear, material per material, defined by curves of reduction of the modulus of rigidity and hysteretic increase in damping according to the shearing strain. These materials are constitutive of group of layers of the laminated ground. Each group is generally associated with a geological zone (clay, rock...).

3.11.1 Operand GAMMA

◆ GAMMA = lgamma

Allows to define the list of real increasing ordinate of the X-coordinates of the shearing strain for each family of nonlinear material defined in the column.

3.11.2 Operands G_GMAX/D

◆ G_GMAX = lggma,
◆ D = lisd,

Allow respectively to define the lists of actual values of reduction of the modulus of rigidity and increase in internal damping D, hysteretic half of damping, according to the shearing strain for each nonlinear material running. Each term of these lists corresponds to a value of the list indicated by the operand GAMMA. All these lists must thus have the same cardinal for same material.

Notice 1 :

It is necessary to define a nonlinear material for the last soil horizon corresponding to the substratum which will have for the operand G_GMAX constant values of 1 (not of reduction) and for the operand D constant values of the hysteretic half-value of the damping of the substratum.

Notice 2 :

The functions thus created are prolonged on the left and on the right with the option 'CONSTANT' and interpolated with an option ('LOG', 'FLAX').

3.12 Keyword SLEEP

◆ SLEEP = _F (

Keyword factor répétable allowing the geometrical description of the layers of a laminated ground, that of the characteristics of materials constitutive of these layers, the assignment sleeps by layer of nonlinear materials previously definite by the keyword MATERIAL.

3.12.1 Operands EPAIS/E/NU/RHO/AMOR_HYST

Allow respectively to define the actual values of the thickness, Young modulus, Poisson's ratio, density and initial damping hysteretic of each layer.

3.12.2 Operand NUME_MATE

◆ NUME_MATE = numat

Number of nonlinear material in the order of description of the occurrences of the keyword MATERIAL to assign to the current layer.

3.12.3 Operand GROUP_MA

◆ GROUP_MA = gmaco

Allows to define the name of the surface group of meshes of the current layer. The last occurrence corresponds to a layer of substratum. If this one is not with a grid in the model of the column, then one names to him of the linear group of meshes of the substratum already indicated by the keyword GROUP_MA_SUBSTR.

3.13 Operand COEFF_VARI_MATE

◇ COEF_VARI_MATE = / 1.0, [DEFECT]
/ coevm

Give a factor of total amplification of the Young moduli defined initially in the keyword SLEEP. In addition to the unit value by default, one also generally uses in the studies of dimensioning the values of 1.5 and 0.67.

3.14 Operand COEF_AMPL_ACCE

◇ COEF_AMPL_ACCE = / 1.0, [DEFECT]
/ coeaa

Give a factor of amplification of the signal of acceleration defined initially by the operand FONC_SIGNAL.

3.15 Operand COEFF_GAMMA

◇ COEF_GAMMA = / 0.65, [DEFECT]
/ coega

Give a factor, lower than 1, used to calculate the effective deformation starting from the maximum deformation obtained in each soil horizon during the signal. The value obtained will give the level from which one will determine the variation of the characteristics of nonlinear material constitutive of the layer, by reading on the curves given by the operands D and G_GAMMA keyword MATERIAL.

3.16 Operand CORR_AMOR

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◇ CORR_AMOR = / 'NOT', [DEFECT]
               / 'YES',
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Indicate if one wants or not to correct the hysteretic data of the damping given by material by introducing a new formulation of the modulus of G^* rigidity which corrects the module real G by the formulation of LYSMER, namely that G^* is written:

$$G^* = G[(1 - 2\xi^2) + 2\xi j \sqrt{1 - \xi^2}]$$

This formulation makes it possible to obtain the equality between the actual value of G and the complex module of G^* . This is done by adding the keyword CORR_AMOR equal to 'YES'.

3.17 Operand LIST_FREQ

Makes it possible to the user to introduce a list of frequencies different from that used by default into the calculation of the spectra of answer from oscillator (or SRO) by the option SPEC_OSCI of CALC_FONCTION.

3.18 Operands NMAX_ITER/RESI_RELA

Give the parameters of the iterative process of variation of the characteristics of the materials constituting of the layers. Respectively the maximum number of iterations and the criterion of stop on the relative maximum variation between two successive iterations of the Young modulus on the whole of the soil horizons.

3.19 Operands TABLE_GEQUI_GMAX/TABLE_AMOR_EQUI

Represent an alternative to the description of the characteristics of nonlinear materials, material by material, defined by the keyword factor MATERIAL. One can then give directly tables of values results of an initial definition by this keyword. For example, one will be able respectively to read the contents of these tables produced by a first master key of DEFI_SOL_EQUI in the case test SDNX100E :

- the table indicated by TABLE_GEQUI_GMAX will contain following information on the variation reduction of the modulus of rigidity by material :

EPSI	GG1	GG2	GG3	GG4
1.000000E-06	1.000000E+00	1.000000E+00	1.000000E+00	1.000000E+00
3.000000E-06	1.000000E+00	9.900000E-01	9.800000E-01	1.000000E+00
1.000000E-05	9.900000E-01	9.600000E-01	9.300000E-01	1.000000E+00
3.000000E-05	9.600000E-01	8.900000E-01	8.300000E-01	1.000000E+00
1.000000E-04	8.400000E-01	7.500000E-01	6.400000E-01	1.000000E+00
3.000000E-04	6.600000E-01	5.400000E-01	4.300000E-01	1.000000E+00
1.000000E-03	3.700000E-01	3.000000E-01	2.200000E-01	1.000000E+00
3.000000E-03	1.900000E-01	1.500000E-01	1.100000E-01	1.000000E+00
1.000000E-02	8.000000E-02	7.000000E-02	5.000000E-02	1.000000E+00

- the table indicated by TABLE_AMOR_EQUI will contain following information on the variation hysteretic increase in damping by material :

EPSI	DG1	DG2	DG3	DG4
1.000000E-06	2.500000E-02	2.500000E-02	2.500000E-02	1.000000E-02
3.000000E-06	2.500000E-02	2.500000E-02	2.500000E-02	1.000000E-02
1.000000E-05	2.500000E-02	2.500000E-02	2.500000E-02	1.000000E-02
3.000000E-05	2.500000E-02	2.500000E-02	3.000000E-02	1.000000E-02
1.000000E-04	2.500000E-02	3.000000E-02	4.000000E-02	1.000000E-02
3.000000E-04	3.000000E-02	4.000000E-02	5.000000E-02	1.000000E-02
1.000000E-03	4.000000E-02	5.000000E-02	7.000000E-02	1.000000E-02
3.000000E-03	5.000000E-02	7.000000E-02	1.000000E-01	1.000000E-02
1.000000E-02	7.000000E-02	1.000000E-01	1.350000E-01	1.000000E-02

Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

3.20 Operand TABLE_MATER_ELAS

Represent an alternative to the geometrical description of the horizons soil laminated and that of the characteristics of materials constitutive of these layers, defined by the keyword factor SLEEP. One can then give directly a table of values results of an initial definition by this keyword. For example, one will be able respectively to read the contents of this table produced by a first master key of DEFI_SOL_EQUI in the case test SDNX100E :

- the table indicated by TABLE_MATER_ELAS will contain following information on the geometrical description of the horizons soil laminated and that of the initial characteristics of materials constitutive of these layers, sleeps by layer :

Y	M	RHO	E _{max}	NU	AH	GDgam	
1.90000E+00	COUCH1A	2.65000E+03	2.67000E+08	4.90000E-01	5.00000E-02		1
3.80000E+00	COUCH1B	2.65000E+03	2.67000E+08	4.90000E-01	5.00000E-02		1
5.70000E+00	COUCH1C	2.65000E+03	2.67000E+08	4.90000E-01	5.00000E-02		1
7.60000E+00	COUCH1D	2.65000E+03	2.67000E+08	4.90000E-01	5.00000E-02		1
9.50000E+00	COUCH2A	2.65000E+03	3.35000E+08	4.90000E-01	5.00000E-02		1
1.14000E+01	COUCH2B	2.65000E+03	3.35000E+08	4.90000E-01	5.00000E-02		1
1.33000E+01	COUCH2C	2.65000E+03	3.35000E+08	4.90000E-01	5.00000E-02		1
1.52000E+01	COUCH2D	2.65000E+03	3.35000E+08	4.90000E-01	5.00000E-02		1
1.93250E+01	COUCH3A	2.71000E+03	9.21000E+08	4.70000E-01	5.00000E-02		2
2.34500E+01	COUCH3B	2.71000E+03	9.21000E+08	4.70000E-01	5.00000E-02		2
2.75750E+01	COUCH3C	2.71000E+03	9.21000E+08	4.70000E-01	5.00000E-02		2
3.17000E+01	COUCH3D	2.71000E+03	9.21000E+08	4.70000E-01	5.00000E-02		2
3.58250E+01	COUCH3E	2.71000E+03	9.21000E+08	4.70000E-01	5.00000E-02		2
3.99500E+01	COUCH3F	2.71000E+03	9.21000E+08	4.70000E-01	5.00000E-02		2
4.40750E+01	COUCH3G	2.71000E+03	9.21000E+08	4.70000E-01	5.00000E-02		2
4.82000E+01	COUCH3H	2.71000E+03	9.21000E+08	4.70000E-01	5.00000E-02		2
5.24500E+01	COUCH4A	2.71000E+03	1.39000E+09	4.70000E-01	5.00000E-02		2
5.67000E+01	COUCH4B	2.71000E+03	1.39000E+09	4.70000E-01	5.00000E-02		2
6.09500E+01	COUCH4C	2.71000E+03	1.39000E+09	4.70000E-01	5.00000E-02		2
6.52000E+01	COUCH4D	2.71000E+03	1.39000E+09	4.70000E-01	5.00000E-02		2
6.94500E+01	COUCH4E	2.71000E+03	1.39000E+09	4.70000E-01	5.00000E-02		2
7.37000E+01	COUCH4F	2.71000E+03	1.39000E+09	4.70000E-01	5.00000E-02		2
7.79500E+01	COUCH4G	2.71000E+03	1.39000E+09	4.70000E-01	5.00000E-02		2
8.22000E+01	COUCH4H	2.71000E+03	1.39000E+09	4.70000E-01	5.00000E-02		2
8.64500E+01	COUCH5A	2.71000E+03	1.96000E+09	4.70000E-01	5.00000E-02		2
9.07000E+01	COUCH5B	2.71000E+03	1.96000E+09	4.70000E-01	5.00000E-02		2
9.49500E+01	COUCH5C	2.71000E+03	1.96000E+09	4.70000E-01	5.00000E-02		2
9.92000E+01	COUCH5D	2.71000E+03	1.96000E+09	4.70000E-01	5.00000E-02		2
1.03450E+02	COUCH5E	2.71000E+03	1.96000E+09	4.70000E-01	5.00000E-02		2
1.07700E+02	COUCH5F	2.71000E+03	1.96000E+09	4.70000E-01	5.00000E-02		2
1.11950E+02	COUCH5G	2.71000E+03	1.96000E+09	4.70000E-01	5.00000E-02		2
1.16200E+02	COUCH5H	2.71000E+03	1.96000E+09	4.70000E-01	5.00000E-02		2
1.21700E+02	COUCH6	2.71000E+03	3.02000E+09	4.50000E-01	5.00000E-02		3
1.27200E+02	COUCH7	2.71000E+03	5.95000E+09	4.50000E-01	5.00000E-02		3
1.37200E+02	COUCH8	2.71000E+03	4.23000E+10	2.50000E-01	2.00000E-02		4

Notice :

The names of the columns given on the first line correspond to the names of the parameters of access of the table. They must be preserved such as they are.

3.21 Operand UNITE_TABLE_RESU

Provides the unit of writing of the table containing the result of the iterative process of DEFI_SOL_EQUI, of which evolution during iterations of calculation of the characteristics of materials constitutive of the laminated layers of ground. One also prints, once convergence reached, the variation with the depth, that is to say layer by layer, the top to the bottom, of maximum accelerations and deformations in the course of time.

3.22 Operand UNIT_RESU_TRAN

Provides the unit of writing to the format 'TABLE' transitory evolutions of accelerations, then deformations and then of the stresses shear, obtained in the end of the iterative process of DEFI_SOL_EQUI. These evolutions are printed, column by column, successively: in free field, with the levelling rock, then with the bottom of each horizon soil laminated, top downwards.

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3.23 Operand UNIT_RESU_SPEC

Provides the unit of writing to the format 'TABLE' frequential evolutions of the spectra of answer (SRO) in acceleration obtained in the end of the iterative process of DEFI_SOL_EQUI. These evolutions are printed, column by column, successively: in free field, with the levelling rock, then with the bottom of each horizon soil laminated, top downwards.

3.24 Operand TITLE

◇ TITLE = title

Allows the user to define a title for the table of ground.

3.25 Operand INFORMATION

◇ INFORMATION =

Indicate a level of impression for information in the file "MESSAGE":

INFORMATION = 1 : no impression

INFORMATION = 2 : impression of the table of ground