SDLL107 - Transitory calculation of a beam under random excitation

Summary:

The objective of this CAS-test is to calculate the temporal answer of a beam under random excitation of spectral concentration of power (DSP) and whose displacements are limited in several points by obstacles:

- The beam is subjected has random requests,
- The obstacle is characterized by a normal rigidity of shock and a coefficient of friction.

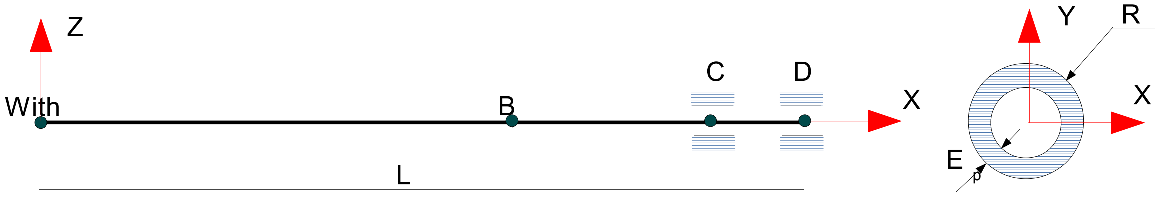
One determines, on the level as of obstacles, several sizes characterizing the behavior:

- Average displacement,
- Value RMS normal force,
- Median value of the tangent force,
- Power of wear

This test is carried out on a beam made up of elements SEG2 and of circular section.

1 Problem of reference

1.1 Geometry



Geometry of the beam (m) :

$L=1.5$
$R=0.005$
$e_p=0.0005$

Coordinates of the points (m) :

$A:(0.0,0.0,0.0)$
$B:(1.,0.0,0.0)$
$C:(1.38,0.0,0.0)$
$D:(1.5,0.0,0.0)$

1.2 Elastic properties of material

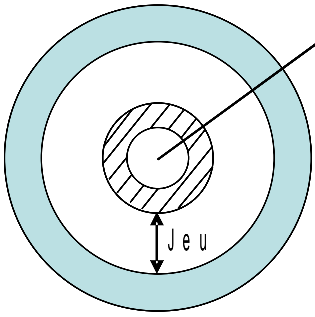
- $E=2.0E11\,Pa$ Young modulus
- $\nu=0.3$ Poisson's ratio
- $\rho=7900.0\,kg.m^{-3}$ Density

1.3 Boundary conditions and loadings

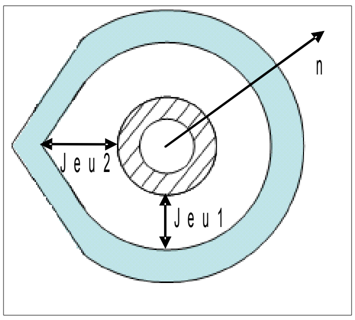
- Imposed displacement:
- All nodes: $DRX=DRY=DX=DZ=0.0$
- Not A : $DY=DRZ=0.0$

- Imposed loading:
- Not B : random force according to Y
- Not B : random moment around Z

- Obstacle (CIRCLE) at the point D :
  - Game = $0 \quad m$
  - normalizes = $(1.,0.,0.)$
  - origin = $(1.,0.,0.)$
  - Normal rigidity: $RIGI\_NOR=10^6 N/m$
  - Friction COULOMB : $COULOMB=0.3$



- Obstacle (DISCRETE) at the point C :
  - normalizes = $(1.,0.,0.)$
  - origin = $(1.,0.,0.)$
  - Normal rigidity: $RIGI\_NOR=100. N/m$
  - Friction COULOMB : $COULOMB=0.3$



- Jeu1 = $1.0 \quad m$
- Jeu2 = $1.5 \quad m$

2 Reference solution

2.1 Calculation of reference

A reference is used NON_REGRESSION to test the various quantities calculated on the level of the obstacles.

The procedure of calculation is the following one, one:
- Calculate the modal base,
- Create matrix interspectrale (or DSP) starting from complex functions,
- Generate the random efforts,
- Calculate transitory dynamic response,
- Test of the values of the answer (displacements and efforts) to the level of the obstacles.

2.2 Reference variable

Components of the matrix interspectrale obtained starting from the complex functions.

Size	Component	Comments
DEPL_X	MEANS	Median value of displacement according to X , with not shock, in their local reference mark,
DEPL_Y	ECART_TYPE	Value of the standard deviation of displacement according to Y , with not shock, in their local reference mark,
DEPL_RADIAL	RMS	Value RMS over the time of shock of "radial displacement" at the point of shock.
DEPL_ANGULAIRE	MAXIMUM	Maximum value of "angular displacement" at the point of shock.
FORCE_NORMALE	RMS_T_TOTAL	Value RMS over the total time of the normal force at the point of shock.
FORCE_TANG_1	MEANS	Median value of the tangent force in the plan of the obstacle.
FORCE_TANG_2	ECART_TYPE	Value of the standard deviation tangent force orthogonal with the plan of the obstacle.
STAT_CHOC	T_CHOC_MOYEN	Time of average shock
STAT_USURE	PUIS_USURE	Power of wear calculated according to ARCHARD.

2.3 Result of reference

	Component	Reference
Matrix interspectrale	$(1,1)$	$0.1000+0.j$
	$(2,2)$	$0.025+0.j$

Notice :
the behavior of the generator of random numbers (module `RANDOM`*) changed since the version* 2.3 *of python. The results are some a little affected. For the tests on the transitory dynamic response, one thus tests with sizes and results of reference different according to the versions from python.*

Version python lower than 2.3			
Size	Component	Not	Reference
DEPL_X	MEANS	D	$0.5\,m$
DEPL_Y	ECART_TYPE	D	$2.57\times10^{-5}\,m$
DEPL_RADIAL	RMS	D	$2.573\times10^{-5}\,m$
FORCE_NORMALE	RMS_T_TOTAL	D	$25.73\,N$

Version python higher than 2.3			
Size	Component	Not	Reference
DEPL_X	MEANS	D	$0.5\,m$
DEPL_Y	ECART_TYPE	D	$2.456\times10^{-5}\,m$
DEPL_RADIAL	RMS	D	$2.456\times10^{-5}\,m$
FORCE_NORMALE	RMS_T_TOTAL	D	$24.56\,N$
DEPL_ANGULAIRE	MAXIMUM	C	$180.\,rad$
FORCE_TANG_1	MEANS	D	$0.$
FORCE_TANG_2	ECART_TYPE	D	$0.$
STAT_CHOC	T_CHOC_MOYEN	C	$0.$
STAT_USURE	PUIS_USURE	C	$0.$

3 Modeling A

3.1 Characteristics of modeling A

Modeling POU_D_T :

Many nodes	76			
Many meshs	75	That is to say:		
			SEG2	75

Group of meshs:

LIS1 : together meshs SEG2 beam

3.2 Sizes tested and results

	Component	Reference	Tolerance (%)
Matrix interspectrale	(1,1)	0.100+0.j	10
Matrix interspectrale	(2,2)	0.025+0.j	10

3.2.1 Version python lower than 2.3

Size	Component	Not	Reference	Tolerance (%)
DEPL_Y	ECART_TYPE	*D*	$2.57\times10^{-5}\,m$	0.1
DEPL_RADIAL	RMS	*D*	$2.573\times10^{-5}\,m$	0.1
FORCE_NORMALE	RMS_T_TOTAL	*D*	$25.73\,N$	0.1

3.2.2 Version python higher than 2.3

Size	Component	Not	Reference	Tolerance (%)
DEPL_Y	ECART_TYPE	*D*	$2.456\times10^{-5}\,m$	0.1
DEPL_RADIAL	RMS	*D*	$2.456\times10^{-5}\,m$	0.1
FORCE_NORMALE	RMS_T_TOTAL	*D*	$24.56\,N$	0.1
DEPL_ANGULAIRE	MAXIMUM	*C*	$180.\,rad$	0.1
FORCE_TANG_1	MEANS	*D*	0.	0.1
FORCE_TANG_2	ECART_TYPE	*D*	0.	0.1
STAT_CHOC	T_CHOC_MOYEN	*C*	0.	0.1

STAT_USURE	PUIS_USURE	C	0.	0.1

4 Summary of the results

The got results are satisfactory, they allow validate the case test.