SDLL106 - Beam subjected to an excitation random distributed

Summary:

An bi--embedded beam is subjected over all its length to an effort distributed. The profile of distribution of the force is identical to all the frequencies.

The random movement of this beam is evaluated by a stochastic approach: one determines the spectral concentration of power of displacement in various points of the beam.

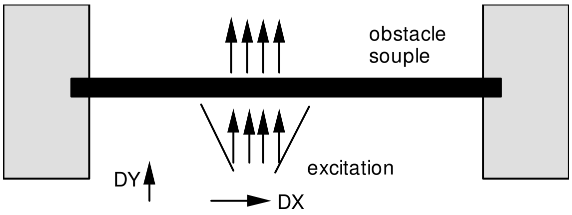
The two possibilities are tested:

- space function of the efforts applied with interspectre unit (method 1),
- interspectre builds directly for the excited ddl (method 2).

This test is an illustration of the answer of a structure subjected to a Wind excitation.

1 Problem of reference

1.1 Geometry



Beam:

Square section: $0.001\,m \times 0.001\,m$
Length: $0.8\,m$

One does not take account of the field of gravity.

1.2 Material properties

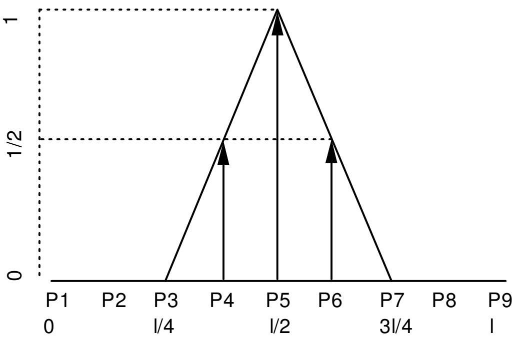
Young modulus:	$E=2.1\,E+11\,N$
Coefficient of compressibility:	$\nu=0.3$
Density:	$\rho=7000\,kg/m^3$

1.3 Boundary conditions and loadings

The beam is embedded at the two ends.

The degree of freedom DZ is blocked in any point.

The effort applied is distributed with the following space distribution:



2 Reference solution

2.1 Method of calculating used for the reference solution

Direct calculation defines an assembled vector of space distribution of the effort and applies the spectral concentration of effort $G_{FF}(\omega)$ on this distribution (method 1).

Broken up calculation defines the excitation as a matrix interspectrale of dimension 3 (equal to the number of excited nodes) and applies, in effort imposed on the nodes, the following matrix interspectrale (method 2):

$$\begin{bmatrix} \frac{1}{4} & \frac{1}{2} & \frac{1}{4} \\ \frac{1}{2} & 1 & \frac{1}{2} \\ \frac{1}{4} & \frac{1}{2} & \frac{1}{4} \end{bmatrix} G_{FF}(\omega)$$

The two results must be identical without any approximation.

2.2 Results of reference

Spectral concentration of power of displacement of the node $P3$ at the frequencies: $4.,6.,8.,10.$ and $12\,Hz$.

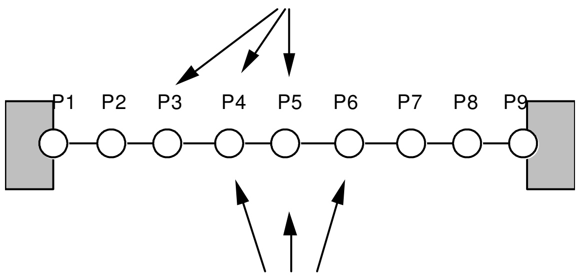
2.3 Bibliographical references

1) C. DUVAL “Dynamic response under random excitation in *Code_Aster* : theoretical principles and examples of use” - Notes HP-61/92.148

3 Modeling A

3.1 Characteristics of modeling

Discrete element in translation of the type DIS_T



Elements of beam: POU_D_T

The exiting spectral concentration is a white vibration of level 1.

The first 2 clean modes were taken into account in calculation.

Damping is introduced in the form of modal damping into the operator of dynamic response random. For all the calculation cases, it is taken equal to 5%

3.2 Characteristics of the grid

Many nodes: 9

Many meshs and types: 8 SEG2

3.3 Remarks

The spectral concentrations are expressed in their physical unit. For a force it will be in N^2/Hz .

3.4 Sizes tested and results

Spectral concentration of displacement at point AM10:

Frequency	Method 1	Method 2	% difference
$4\ Hz$	4.0298E-02	4.0298E-02	0%
$6\ Hz$	9.2971E-02	9.2971E-02	0%
$8\ Hz$	9.5164E-01	9.5164E-01	0%
$10\ Hz$	1.7617E-01	1.7617E-01	0%
$12\ Hz$	2.6695E-02	2.6695E-02	0%

4 Summary of the results

Method 1 (space distribution of the efforts) and the indirect method (by decomposition on the three excited nodes) provide the same result.

This checking ensures a good coherence of the two methods and the quality of their programming.