SDLL105 - Pipe subjected to sources of random fluid excitations

Summarized:

A right pipework embedded at an end in the wall of a tank and supporting a mass at the other end is subjected to a fluid excitation.

The excitation is defined by its power spectral density in the form of a “white vibration”.

It covers all the types of source established in the code:

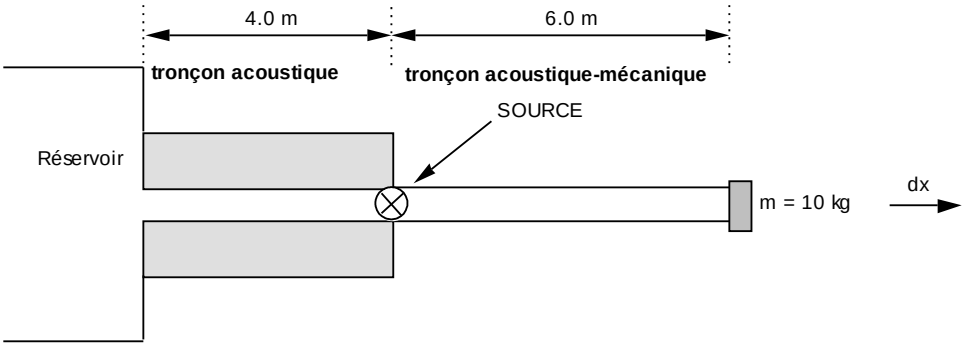
- source of flow-volume,
- source of flow-mass,
- source of pressure,
- source of force,
- imposed force.

One is interested in the power spectral density of the response in a degree of freedom of pressure located on the node supporting the mass.

The random dynamic response is given here moving absolute motion.

1 Problem of reference

1.1 Geometry



circular Pipe of section:

External diameter: $0.1\,m$
Thickness: $3\,mm$

One does not take account of the field of gravity.

1.2 Material properties

Modulus Young of the pipe:	$E=2.1\,E+11\,N$
Coefficient of compressibility of the pipe:	$\nu=0.3$
Density of the pipe:	$\rho=7800\,kg/m^3$
Density of the fluid:	$\rho_f=8.3\,kg/m^3$
Celerity of the fluid:	$c=495\,m/s$

1.3 Boundary conditions and loadings

the degrees of freedom $dy\,,dz\,,drx\,,dry\,,drz$ are blocked for all the pipe.

On the acoustic section dx is also blocked and the only free degrees of freedom are $PRES$ and PHI.

At the end on the side tank: $PRES=0.\quad PHI=0.$

2 Reference solution

2.1 Method of calculating used for the reference solution

No reference solution. The values tested for the NON-regression are those obtained with version 3.02.17.

2.2 Results of reference

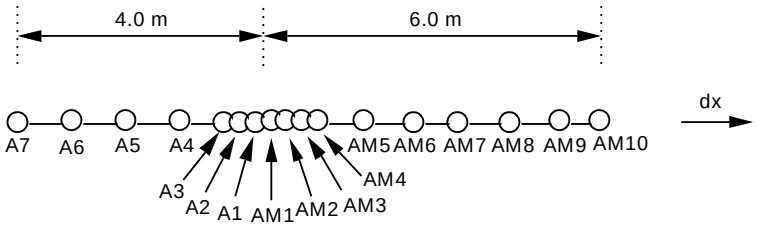
Power spectral density of the pressure to the node at the right end of the tube, the frequencies $10, 12, 14, 36, 38, 40\ Hz$. These frequencies are close to the two eigenfrequencies taken into account (12.38 and $37.36\ Hz$).

2.3 Bibliographical references

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

3 Modelization A

3.1 Characteristic of the modelization



Elements used for the pipes: FLUI_STRU

Element used for the mass in $AM10$: DIS_T

In all the calculation cases, the exiting spectral concentration is a white vibration of level 1.

The sources of flow-volume and flow-rate pressure are applied to the node $AM1$.
The sources of mass and force are applied between the nodes $AM1$ and $AM2$.

The last calculation case corresponds to a force imposed on the node $AM10$ in the meaning dx .

The eigen modes of frequency in the interval $[0,100\,Hz]$ were taken into account in computation, that is to say the first two modes.

The damping is introduced under modal shape into the operator of dynamic response random. For all the calculation cases, it is taken equal to 1%

3.2 Characteristics of the mesh

Many nodes: 17

Number of meshes and types: 16 SEG2, 1 POI1

3.3 Remarks

the spectral concentrations of fluid source are expressed in their physical units. For a source of volume flow rate in $(m^3/s)^2/Hz$.

3.4 Values of NON-regression tested

Values of the spectral concentration of acceleration to point: *PB25*

Standard	frequency of source	*Aster*
10 Hz	SOUR_DEBI_VOLU	9.1954E+11
12 Hz	SOUR_DEBI_VOLU	4.3709E+13
14 Hz	SOUR_DEBI_VOLU	3.6428E+12
36 Hz	SOUR_DEBI_VOLU	1.1142E+13
38 Hz	SOUR_DEBI_VOLU	3.6976E+13
40 Hz	SOUR_DEBI_VOLU	2.6238E+12
10 Hz	SOUR_DEBI_MASS	1.3347E+10
12 Hz	SOUR_DEBI_MASS	6.3448E+11
14 Hz	SOUR_DEBI_MASS	5.2879E+10
36 Hz	SOUR_DEBI_MASS	1.6173E+11
38 Hz	SOUR_DEBI_MASS	5.3675E+11
40 Hz	SOUR_DEBI_MASS	3.8088E+10
10 Hz	SOUR_PRESS	9.5991E+00
12 Hz	SOUR_PRESS	2.5952E+02
14 Hz	SOUR_PRESS	1.2365E+01
36 Hz	SOUR_PRESS	3.2428E+00
38 Hz	SOUR_PRESS	1.3681E+01
40 Hz	SOUR_PRESS	1.1649E+00
10 Hz	SOUR_FORCE	1.9931E+05
12 Hz	SOUR_FORCE	5.3887E+06
14 Hz	SOUR_FORCE	2.5675E+05
36 Hz	SOUR_FORCE	6.7334E+04
38 Hz	SOUR_FORCE	2.8408E+05
40 Hz	SOUR_FORCE	2.4189E+04
10 Hz	EFFO	2.6542E-03
12 Hz	EFFO	4.5780E-02
14 Hz	EFFO	9.0980E-04
36 Hz	EFFO	3.3472E-02
38 Hz	EFFO	0.1186
40 Hz	EFFO	8.8587E-03

4 Summary of the results

This test makes it possible to pass in the options corresponding to the various types of source. It is primarily about a test developer.

Not having a reference solution, it is simply a question of not regressing between the versions.