SDLS113 – Plate in plane strain under harmonic pressure

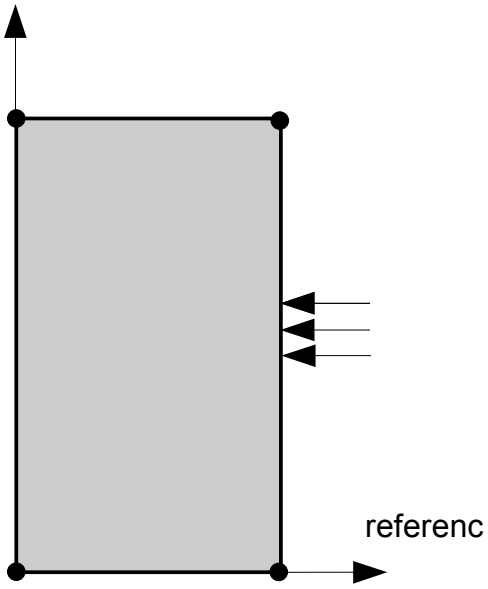
Abstract:

The purpose of this benchmark is to validate the computation of a plate in plane strain (D_PLAN) subjected to a sinusoidal pressure using a harmonic computation.

For that, one carries out two computations on the same model, a harmonic computation and a transient computation. The computation transitory is used as reference.

1 Problem of XYABDCpGéométrie

1.1



Coordinated of the points expressed in meters:

$A:(0.0,0.0)$
$B:(0.35,0.0)$
$C:(0.35,0.6)$
$D:(0.0,0.6)$

1.2 Elastic properties of the material

- $E=1.8\times10^{11}\ Pa$ Modulus Young
- $\nu=0.3$ Poisson's ratio
- $\rho=7800.0\ kg.m^{-3}$ Density
- $\alpha=3\times10^{-5}\ s$
- $\beta=0.001\ s^{-1}$

the coefficients α and β make it possible to build a viscous damping matrix proportional to the stiffness and the mass $[C]=\alpha[K]+\beta[M]$.

1.3 Boundary conditions and loadings

•Fixed support on the side AD
$DX=0.0\,m$, $DY=0.0\,m$

•on the east side BC subjected to a harmonic pressure of amplitude $p=10^5\ Pa$ to a frequency $f=1500\ Hz$

2 Reference solution

2.1 Method of calculating

It is a question of calculating the response of a plate subjected to a harmonic pressure on a side of the plate and embedded on the opposite side.

The reference solution is obtained by carrying out a computation of transient response with operator DYNA_VIBRA by means of the diagram of integration of Newmark with the parameters $alpha=0.25$ and $delta=0.5$.

2.2 Quantities and results of reference

One proposes to test the following quantities:

- Displacement following x to the point of coordinates $(0.0816, 0.165)$
- Forced and strain to the Gauss point of a mesh containing the node of coordinates $(0.3383, 0.39)$
- Forced and strain to the node of coordinates $(0.3383, 0.39)$

2.3 Uncertainties on the solution

One considers that the mode is established at the end of 90 periods. The values of reference selected are those raised on 98ième and the 99ième periods of the transient response.

3 Modelization A

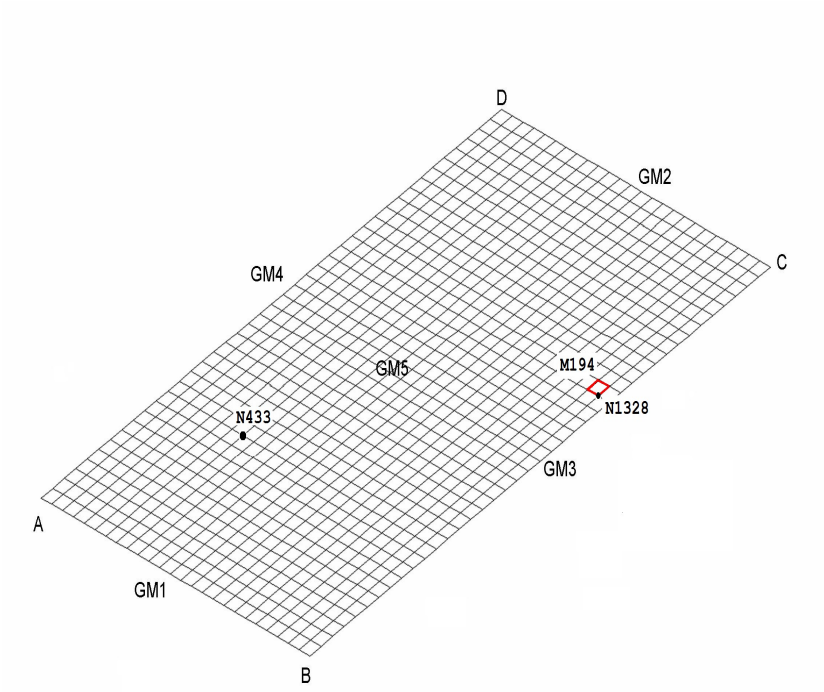
3.1 Characteristic of the modelization A

Modelization D_PLAN

3.2 Characteristics of the mesh

Many nodes: 1271
Number of meshes:
SEG2 : 140
QUAD4 : 1200

Mesh group:
GM1 : dimensioned *AB*
GM2 : dimensioned *CD*
GM3 : dimensioned *BC*
GM4 : dimensioned *AD*
GM5 : face *ABCD*



$N433 : (0.0816, 0.165)$
$N1328 : (0.3383, 0.39)$

3.3 Quantities tested and results

Identification	Reference
DX to the node N433	$3.9896\,E-8\,m$
SIXX at the Gauss point number 1 of the mesh M194	$98461\,Pa$
SIXX with the node N1328 of the mesh M194	$98100\,Pa$
EPXX at the Gauss point number 1 of the mesh M194	$5.2747\,E-7$
EPXX with the node N1328 of the mesh M194	$5.2772\,E-7$

One calculates kinetic energy ECIN_ELEM of the mesh $M194$:

Component	option	Reference (NON_REGRESSION)	*Aster*	tolerance
harmonic Computation				
ECIN_ELEM	TOTAL	1.91599 10-6	1.9159851 10-6	0.1%
Transient computation				
ECIN_ELEM	TOTAL	1.78915 10-6	1.7891507 10-6	0.1%

4 Summary of the results

the computation results of the harmonic response are very close to those obtained with an equivalent transient computation which was used as reference.