

## SDLS113 – Plate in deformation planes under harmonic pressure

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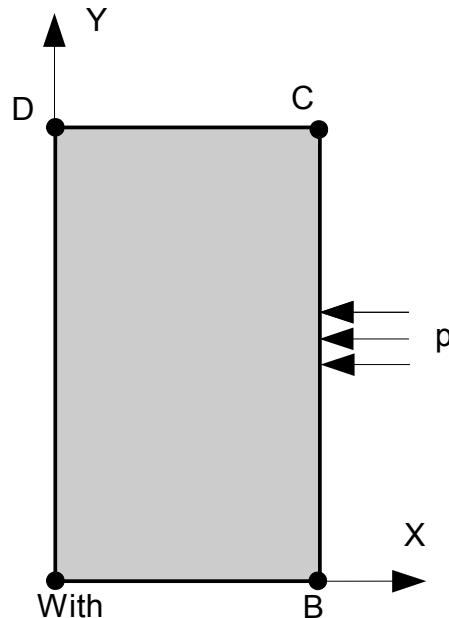
### Summary:

The objective of this CAS-test is to validate the calculation of a plate in plane deformation ( $D\_PLAN$ ) subjected to a sinusoidal pressure using a harmonic calculation.

For that, one carries out two calculations on the same model, a harmonic calculation and a transitory calculation. Transitory calculation is used as reference.

## 1 Problem of reference

### 1.1 Geometry



Coordinates 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 material

- $E = 1.8 \times 10^{11} Pa$  Young modulus
- $\nu = 0.3$  Poisson's ratio
- $\rho = 7800.0 kg.m^{-3}$  Density
- $\alpha = 3 \times 10^{-5} s$
- $\beta = 0.001 s^{-1}$

Coefficients  $\alpha$  and  $\beta$  allow to build a matrix of viscous damping proportional to rigidity and the mass  $[C] = \alpha [K] + \beta [M]$ .

### 1.3 Boundary conditions and loadings

- Embedding on the side  $AD$   
 $DX = 0.0 m$ ,  $DY = 0.0 m$

- The side  $BC$  is subjected to a harmonic pressure of amplitude  $p = 10^5 Pa$  at a frequency  $f = 1500 Hz$

## 2 Reference solution

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### 2.1 Method of calculating

It is a question of calculating the answer 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 transitory calculation of answer with the operator `DYNA_VIBRA` by using the diagram of integration of Newmark with the parameters  $\alpha=0.25$  and  $\delta=0.5$ .

### 2.2 Sizes and results of reference

One proposes to test the following sizes:

- Following displacement  $x$  at the point of coordinates  $(0.0816, 0.165)$
- Constraint and deformation at the point of Gauss of a mesh containing the node of coordinates  $(0.3383, 0.39)$
- Constraint and deformation with the node of coordinates  $(0.3383, 0.39)$

### 2.3 Uncertainties on the solution

It is considered that the mode is established at the end of 90 periods. The values of reference selected are those raised on the 98<sup>ième</sup> and 99<sup>ième</sup> periods of the transitory answer.

## 3 Modeling A

### 3.1 Characteristics of modeling A

Modeling D\_PLAN

### 3.2 Characteristics of the grid

Many nodes: 1271

Many meshes:

SEG2 : 140

QUAD4 : 1200

Group of meshes:

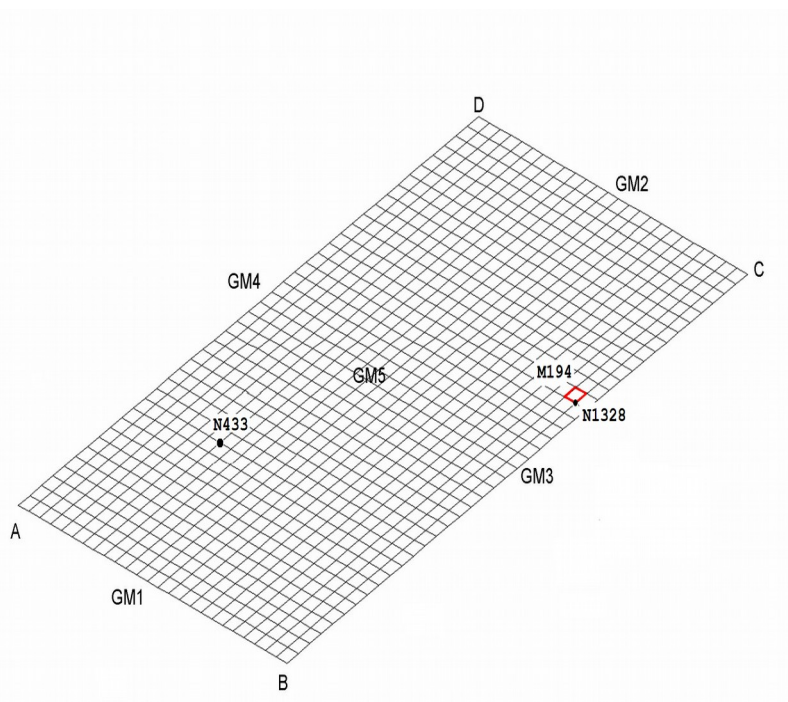
GM1 : dimensioned AB

GM2 : dimensioned CD

GM3 : dimensioned BC

GM4 : dimensioned AD

GM5 : face ABCD



N 433 : (0.0816, 0.165)

N 1328 : (0.3383, 0.39)

## 3.3 Sizes tested and results

Identification	Reference	Type of reference	tolerance
DX with the node N433	$3.9896 E-8 m$	AUTRE_ASTER	0.1 %
SIXX at the point of Gauss number 1 of the mesh M194	$98461 Pa$	AUTRE_ASTER	0.1 %
SIXX with the node N1328 mesh M194	$98100 Pa$	AUTRE_ASTER	0.1 %
EPXX at the point of Gauss number 1 of the mesh M194	$5.2747 E-7$	AUTRE_ASTER	0.1 %
EPXX with the node N1328 mesh M194	$5.2772 E-7$	AUTRE_ASTER	0.1 %

The kinetic energy is calculated ECIN\_ELEM mesh M194 :

Option	Component	Reference	Type of reference	tolerance
<b>Harmonic calculation</b>				
ECIN_ELEM	TOTAL	$1.91599 10^{-6}$	NON_REGRESSION	-
<b>Transitory calculation</b>				
ECIN_ELEM	TOTAL	$1.78915 10^{-6}$	NON_REGRESSION	-

## 4 Modeling B

### 4.1 Characteristics of modeling B

Modeling B is a copy of the modeling A in which one replaced material ELAS by a material ELAS\_ORTH isotropic in order to validate the taking into account of the parameters of damping in this case.

### 4.2 Sizes tested and results

Modeling A is used as reference for all the sizes tested.

Identification	Reference	TYPE of reference	Tolérance
DX with the node N433	3.99011179996e-08 m	AUTRE_ASTER	1E-4 %
SIXX at the point of Gauss number 1 of the mesh M194	98510.5400395 Pa	AUTRE_ASTER	1E-4 %
SIXX with the node N1328 mesh M194	98149.5819288 Pa	AUTRE_ASTER	1E-4 %
EPXX at the point of Gauss number 1 of the mesh M194	5.27795672536e-07	AUTRE_ASTER	1E-4 %
EPXX with the node N1328 mesh M194	5.27546476125e-07	AUTRE_ASTER	1E-4 %

The kinetic energy is calculated ECIN\_ELEM mesh M194 :

Option	Component	Reference	TYPE of reference	tolerance
<b>Harmonic calculation</b>				
ECIN_ELEM	TOTAL	1.91599 10 <sup>-6</sup>	AUTRE_ASTER	1E-4 %
<b>Transitory calculation</b>				
ECIN_ELEM	TOTAL	1.78915 10 <sup>-6</sup>	AUTRE_ASTER	1E-4 %

## 5 Summary of the results

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The computation results of the harmonic answer are very close to those obtained with a transitory calculation are equivalent which was used as reference.