SDLS08 - Clean modes of a square plate calculated on reduced basis

Summary:

This case test aims to test the calculation of the clean modes of a square plate with static condensation of the matrices assembled on the internal degrees of freedom and the restitution on physical basis.

The test is carried out with a modeling DKT, of which only one node is left free. One applies a unit stress to this node.

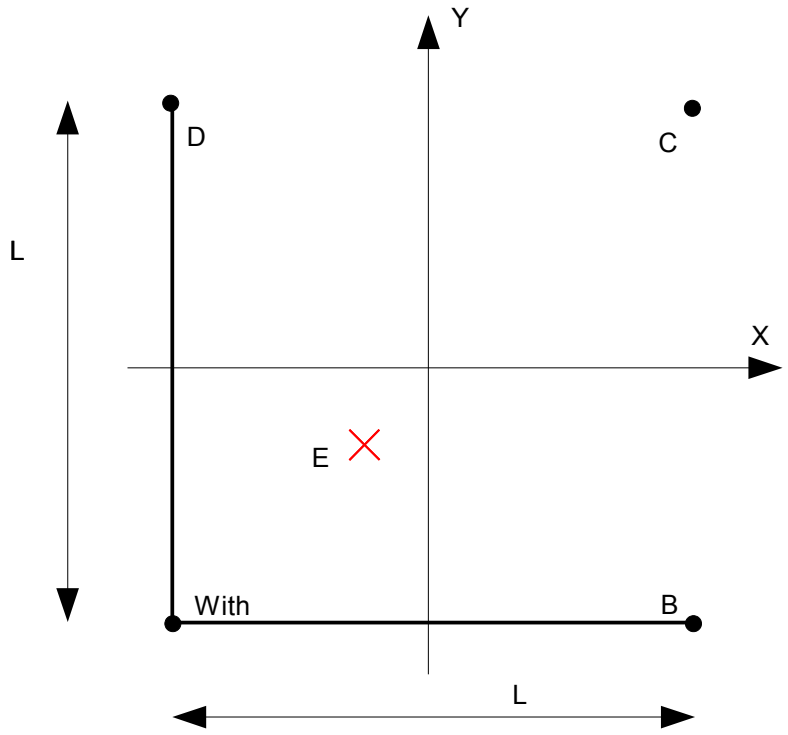
In a first part, one tests the construction of a base modal obtained starting from the assembly two bases of dynamic clean modes.

Then, one calculates the base of static modes, on which the matrices of mass and rigidity are projected. The clean modes are then calculated on this basis. The results are restored in the physical base.

The last stage consists has to carry out a harmonic calculation on the basis of reduced static mode. The results are also restored in physical base.

1 Problem of reference

1.1 Geometry



Geometry of the plate (m):

$L=1$
thickness $e=0.001$

Coordinates of the points (m) :

$O(0.0,0.0)$
$E(-0.1,-0.1)$

Group of meshs:

$CONT\_NO$: Dimensioned AB, BC, CD, DA
$COND2\_NO$: Face $ABCD$ except the point E

1.2 Elastic properties of material

- $E = 7.1\text{E}10\ Pa$ Young modulus
- $\nu = 0.3$ Poisson's ratio
- $\rho = 7820.0\ kg.m^{-3}$ Density
- $AMOR\_ALPHA = 0.5\ N.s.m^{-1}$
- $AMOR\_BETA = 0.1\ N.kg^{-1}$

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

1.3 Boundary conditions and loadings

- Imposed displacement:
  - $CONT\_NO$: worthless displacements and rotations
  - $COND2\_NO$: worthless displacements and rotations
- Force of excitation (N) :
  - Not E : $Fz = 1$

2 Reference solution

2.1 Calculations of reference

Pas de results of reference. The frequencies and displacements are tested by nonregression.

2.2 Sizes and results of reference

- $FREQ$: frequency
- DZ : following displacement z

Got results:

- From a definite modal base starting from the assembly of two bases of dynamic mode.

Component	N° mode	Reference (Hz)
$FREQ$	1	29.0604
	2	76.2281
	3	76.2281
	4	76.2281
	5	5058.51
	6	5058.51

- From a definite modal base starting from static modes

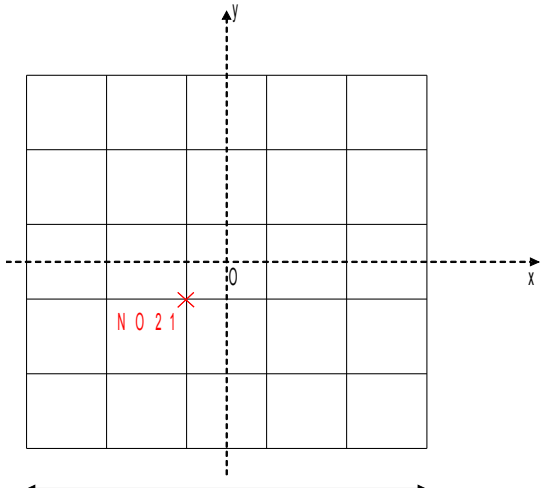
Component	N ° mode	Reference (Hz)
$FREQ$	1	4.9762

- From a harmonic calculation carried out on the basis of modal static mode.

Component		Not	Reference (m)
DZ	Real part	E	2.02777×10^{-6}
	Imaginary part		-5.38827×10^{-5}

3 Modeling A

3.1 Characteristics of modeling



Modeling DKT :

Many nodes 36

Many meshs 25 That is to say:

QUAD4 25

3.2 Sizes tested and results

- Base modal definite starting from the assembly of two bases of dynamic mode

Component	N° mode	Reference (Hz)	Tolerance %
$FREQ$	1	29.0604	10^{-4}
	2	76.2281	10^{-4}
	3	76.2281	10^{-4}
	4	76.2281	10^{-4}
	5	5058.51	10^{-4}
	6	5058.51	10^{-4}

- Base modal definite starting from static modes

Component	N° mode	Reference (Hz)	Tolerance %
$FREQ$	1	4.9762	10

- Harmonic calculation carried out on the basis of modal static mode.

Component		Node	Reference (m)	Tolerance %
DZ	Real part	$NO21$	2.02777×10^{-6}	10.

	Imaginary part		-5.38827×10^{-5}	10.

4 Summary of the results

The got results are satisfactory.