
SSLP100 - Stick in substructure static

Abstract:

This benchmark validates the static substructuring, consistent in the condensation of the stiffness matrixes and the loadings.

One carries out the plane modelization of a structure having a linear behavior.

2 Modelizations:

- Model a: "ordinary" plane: it is the reference solution.
- B: models with substructures.

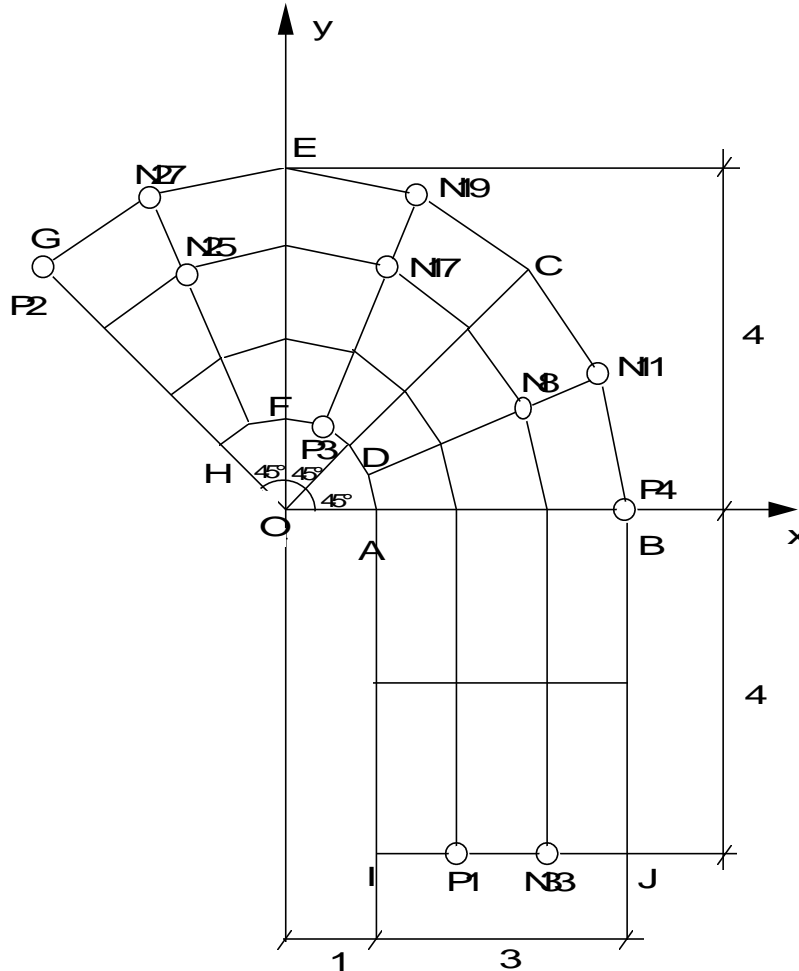
Interest:

- substructuring on two levels,
- rotation of the macro-elements and the loadings (following or not),
- computation of the fields inside the macro-elements.

The results of B are identical to those of A with 10^{-5} near.

1 Problem of reference

1.1 Geometry



1.2 Material properties

$$E = 15. Pa$$

$$\nu = 0.3$$

1.3 Boundary conditions and loadings

- $[GH]$: $u+v=0$; $N8$, $N17$ and $N25$: $u=v=0$; J : $u=2.0$
- loading case 1: distributed pressure on $ADFH$ $p=10.0$
- loading case 2: $N11$ $N19$ $N27$ $N33$ $P1$: $F_y=-20.0$

1.4 Initial conditions

Without object.

2 Reference solution

2.1 Method of calculating used for the reference solution

This problem does not have a reference solution.

The modelization A is used as reference for the modelization B.

2.2 Results of reference

Displacements u and v at the points $P1$ $P2$ $P3$ $P4$.

2.3 Uncertainty on the solution

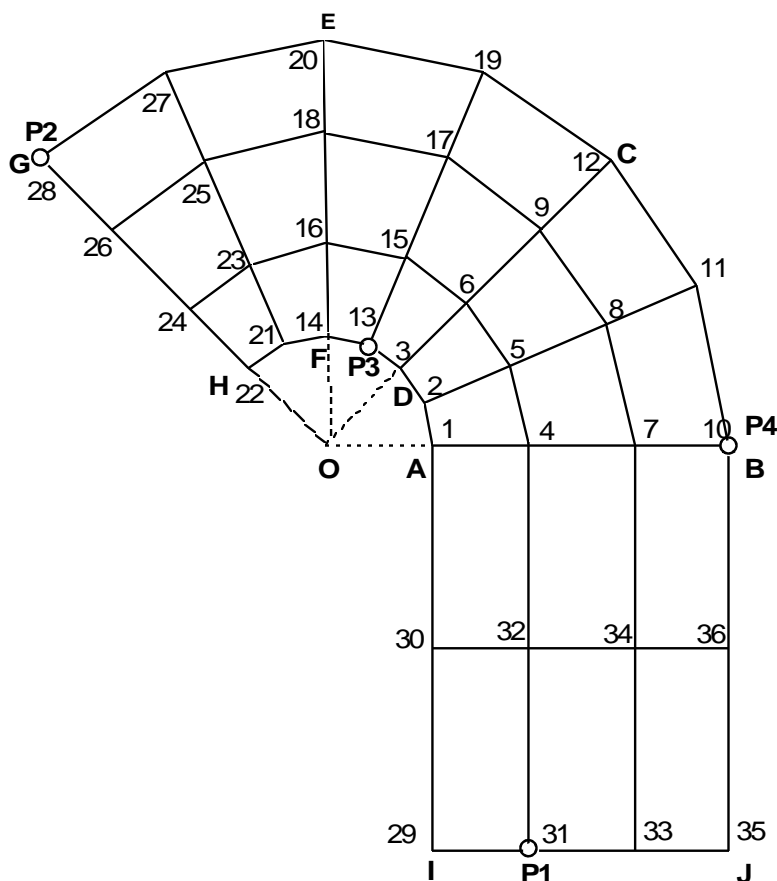
the solution of “reference” depends on the spatial discretization of the model; this is why the mesh is drawn in [§1.1].

The modelization B must respect this mesh to lead to the same results that A.

3 Modélisation A

3.1 Characteristic of the modelization

24 elements QUAD4, modelization: D_PLAN



3.2 Characteristics of the mesh

Many nodes: 36.

Number of meshes and type: 24 QUAD4

3.3 Quantities tested and results

Identification	Reference
P1 u	1.88327
P1 v	2.59224 10-2
P2 u	- 8.27372 10-2
P2 v	8.27372 10-2
P3 u	2.70375 10-1
P3 v	5.69552 10-1
P4 u	5.17703 10-1
P4 v	5.43387 10-1
P1 u	1.71883

cases of
load
n° 1

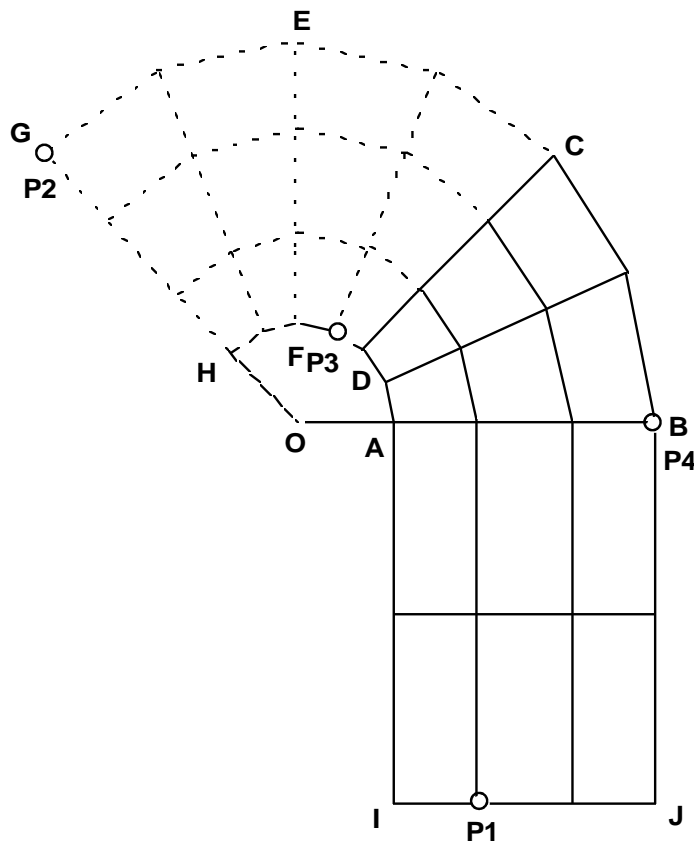
Warning : The translation process used on this website is a "Machine Translation". It may be imprecise and inaccurate in whole or in part and is provided as a convenience.

<i>P1</i>	<i>v</i>	– 6.04367	
<i>P2</i>	<i>u</i>	– 4.60196 10-2	cases of
<i>P2</i>	<i>v</i>	4.60196 10-2	load
<i>P3</i>	<i>u</i>	2.26903 10-1	n° 2
<i>P3</i>	<i>v</i>	– 6.14296 10-1	
<i>P4</i>	<i>u</i>	– 9.57110 10-1	
<i>P4</i>	<i>v</i>	– 2.53878	

These results B constitute the reference of the modelization.

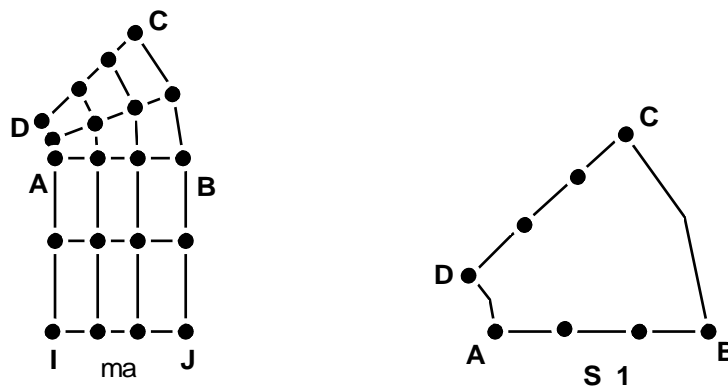
4 Modelization B

4.1 Characteristic of the modelization

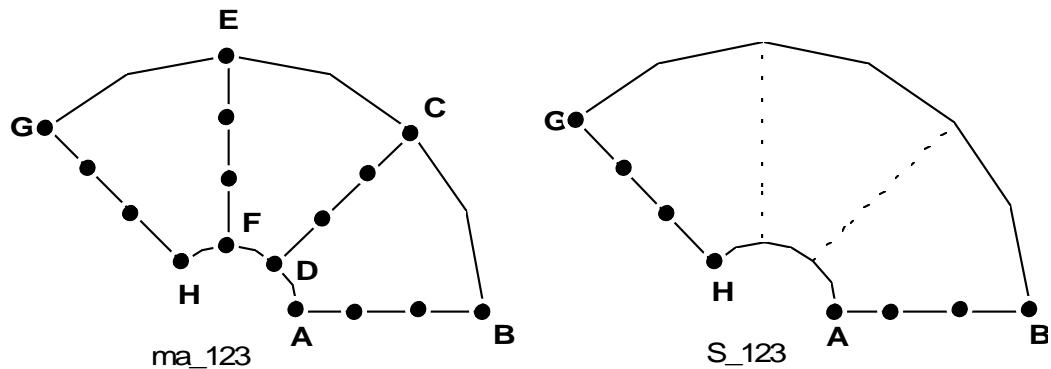


The mesh initial *ma* (level -2 of the substructuring) contains only the 12 QUAD4 of *IJBA* and *ABCD*.

The *macr_elem_stat* (S_1) is defined starting from the elements of *ABCD*. This *macr_elem_stat* is condensed on the nodes of *AB* and *CD* (level -2).



The mesh `ma_123` of level `-1` is defined while making turn twice `S_1` to represent contour `ABCEGHFDA`.

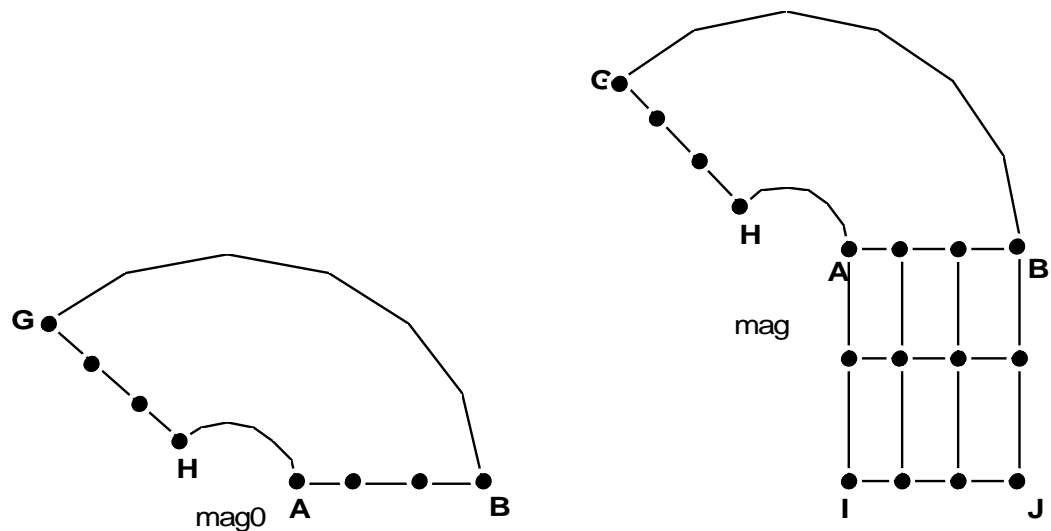


The `macr_elem_stat` `S_123` is defined starting from substructures `ABCD`, `DCEF` and `FEGH`. This `macr_elem_stat` is condensed on the nodes of `AB` and `GH`.

The mesh `mag0` is defined by the `macr_elem_stat` `S_123`.

The mesh final `mag` (level `0`) is defined by the mesh `mag0` which one assembles (`ASSE_MAILLAGE`) with the initial mesh `ma` to recover meshes `IJBA`.

The resolution is then made on this final mesh, then one calculates displacements inside the `macr_elem_stat` using operator `DEPL_INTERNE`.



4.2 Characteristics of the mesh

Many nodes: 20.

Number of meshes and types: 12 QUAD4

4.3 Quantities tested and results

Identification	Reference
<i>P1</i> <i>u</i>	1.88327
<i>P1</i> <i>v</i>	2.59224 10-2
<i>P2</i> <i>u</i>	- 8.27372 10-2

<i>P2</i>	<i>v</i>	8.27372 10-2
<i>P3</i>	<i>u</i>	2.70375 10-1
<i>P3</i>	<i>v</i>	5.69552 10-1
<i>P4</i>	<i>u</i>	5.17703 10-1
<i>P4</i>	<i>v</i>	5.43387 10-1
<i>P1</i>	<i>u</i>	1.71883
<i>P1</i>	<i>v</i>	- 6.04367
<i>P2</i>	<i>u</i>	- 4.60196 10-2
<i>P2</i>	<i>v</i>	4.60196 10-2
<i>P3</i>	<i>u</i>	2.26903 10-1
<i>P3</i>	<i>v</i>	- 6.14296 10-1
<i>P4</i>	<i>u</i>	- 9.57110 10-1
<i>P4</i>	<i>v</i>	- 2.53878

5 Summary of the results

the accuracy of the got results (error $\leq 10^{-5}$) is natural because the static substructuring is an "exact" method (in infinite numerical accuracy).