SDLL132 - Clean modes of a frame in multifibre beams

Summary:

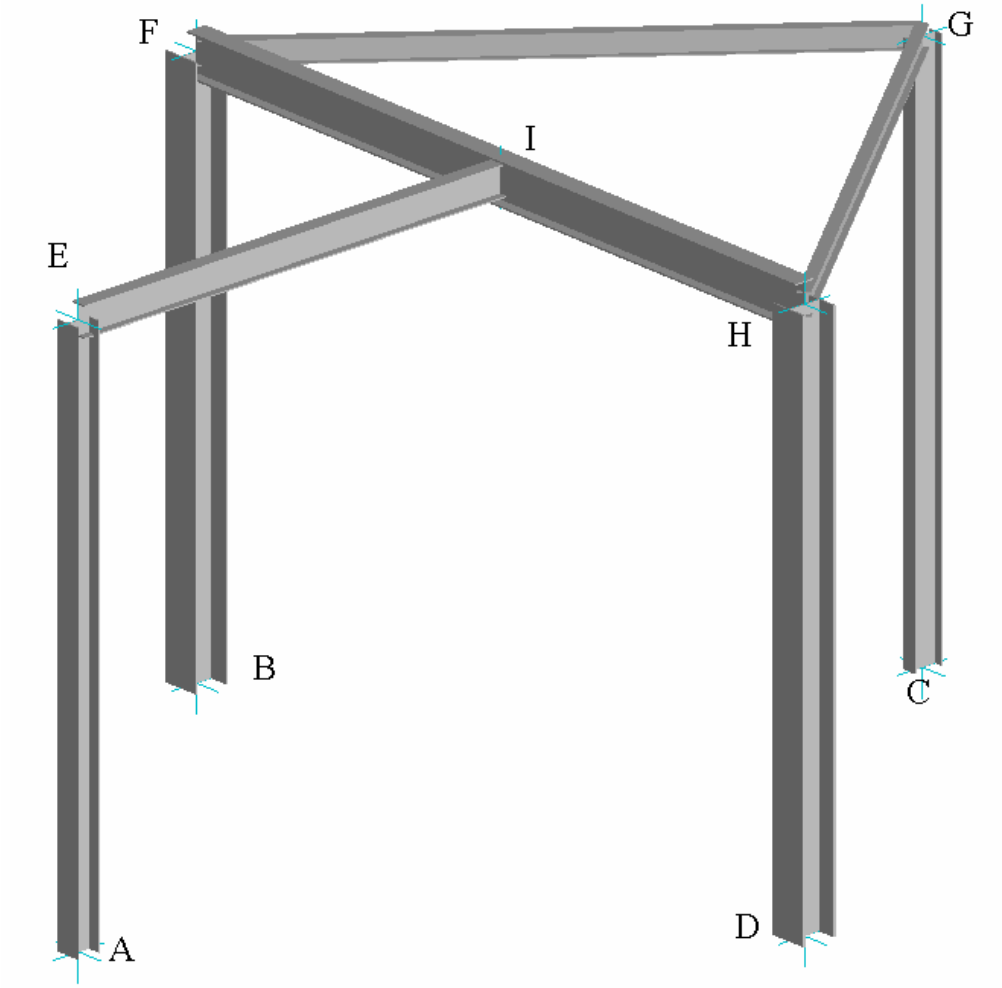
This test relates to the validation of the option MASS_INER, as of the calculation of the clean modes of the frame when the model contains POU_D_TGM (modeling A) or of POU_D_EM (modeling B) (multifibre beams). results of the reference solution are got by making the same study but with a model of POU_D_TG (modeling C) and of POU_D_E (modeling D).

This test makes it possible to validate, by making a modal analysis of the structure:
- linear finite elements of type POU_D_TGM and of type POU_D_EM.
- results of the orders: POST_ELEM, NORM_MODE, EXTR_MODE.
- results of CALC_MODES.

1 Problem of reference

1.1 Geometry

The case test is a metal frame made up of beams and posts.



Coordinates of the principal nodes of the grid:

Not	Coordinate. X (in m)	Coordinate. Y (in m)	Coordinate. Z (in m)
A	2.0	2.5	0.0
B	4.0	0.0	0.0
C	2.0	– 2.5	0.0
D	0.0	0.0	0.0
E	2.0	2.5	3.0
F	4.0	0.0	3.0
G	2.0	– 2.5	3.0
H	0.0	0.0	3.0
I	2.0	0.0	3.0

1.2 Mechanical characteristics of the beams

The beams of the case test are standard sections of the metal structure. The units of their mechanical characteristics are homogeneous with meters.

	HEA200	*IPE220*	*IPE160*	*HEA140*	*IPE120*
Beams	*BF , DH*	*HF*	*EI , CG*	*AE*	*FG , GH*
A	5.39E – 03	3.34E – 03	2.01E – 03	3.14E – 03	1.32E – 03
IY	3.69E – 05	2.77E – 05	8.70E – 06	1.03E – 05	3.18E – 06
IZ	1.34E – 05	2.05E – 06	6.83E – 07	3.89E – 06	2.77E – 07
AY	1.474994	1.789865	1.792884	1.464032	1.774392
AZ	4.466038	2.633754	2.586199	4.464173	2.590182
JX	1.97E – 07	8.66E – 08	3.37E – 08	7.76E – 08	1.63E – 08
JG	1.06E – 07	2.23E – 08	3.89E – 09	1.47E – 08	8.73E – 10

Sizes EY , EZ , $IYR2$, $IZR2$ are worthless for all the beams.

1.3 Properties of material

Only one material is used:

Young	$2.10\mathrm{e}+11\ Pa$
Rho	$7.85\mathrm{e}+03\ kg/m^3$

1.4 Boundary conditions

Points A , B , C , D are embedded.

$$DX=0 \quad DY=0 \quad DZ=0 \quad DRX=0 \quad DRY=0 \quad DRZ=0$$

2 Reference solution

2.1 Method of calculating used for the reference solution

The values of the reference solution are obtained with the frame, produced either with a model containing POU_D_TG maybe with a model containing POU_D_E.

2.2 Results of reference

Values obtained by the order POST_ELEM, with the keyword MASS_INER (even value for all modelings) :

Sizes	Value
MASS	5.85759E+02
CDG_X	2.00000E+00
CDG_Z	2.03968E+00
IX_PRIN_G	1.56562E+03
IY_PRIN_G	1.81822E+03
IZ_PRIN_G	2.23486E+03

The values of reference on the modes are given in the paragraph “Sizes and results tested” for each modeling. It is specified that the modes are filtered by the order EXTR_MODE with the criterion MASS_EFFE_UN and a threshold of 5.0E-04 .

2.3 Uncertainty on the solution

Without object.

3 Modeling A

3.1 Characteristics of modeling and the grid

The model is composed of POU_D_TGM (multifibre beams). All the sections, are in form of "I" and are described with 30 fibres: 1 in the sole and web thickness, 10 in the width of the soles and 10 in the height of the heart.

3.2 Sizes tested and results

As already to specify in introduction, all the results of reference are of type AUTRE_ASTER obtained with modeling POU_D_TG.

The table below summarizes the results got by the orders POST_ELEM, with the keyword MASS_INER.

Sizes	Values References	Precision
MASS	5.8576E+02	1 E – 0 6
CDG_X	2.0000E+00	1E–06
CDG_Z	2.0397E+00	1 E – 0 6
IX_PRIN_G	1.5656E+03	1 E – 0 6
IY_PRIN_G	1.8182E+03	1 E – 0 6
IZ_PRIN_G	2.2349E+03	1 E – 0 6

Mode	PARA	Value of reference	Precision
1	FREQ	9.97491403256	1 E – 0 6
2	FREQ	12.2159676506	1E–06
3	FREQ	12.868960956	1 E – 0 6
4	FREQ	17.2857355599	1 E – 0 6
5	FREQ	18.957859521	1 E – 0 6
6	FREQ	22.0433498853	1 E – 0 6
7	FREQ	26.6404640559	1 E – 0 6
8	FREQ	34.7409020802	1 E – 0 6
9	FREQ	37.4004630214	1 E – 0 6
1	MASS_EFFE_UN_DX	0.244809518115	1 E – 0 6
2	MASS_EFFE_UN_DX	0.430134528182	1 E – 0 6
3	MASS_EFFE_UN_DY	0.532946971892	1 E – 0 6
3	MASS_EFFE_UN_DZ	0.000404337801659	1 E – 0 6
4	MASS_EFFE_UN_DX	0.00129425453011	1 E – 0 6
5	MASS_EFFE_UN_DX	0.0775826535135	1 E – 0 6
6	MASS_EFFE_UN_DY	0.139471255187	1 E – 0 6
7	MASS_EFFE_UN_DY	0.058326978735	1 E – 0 6
8	MASS_EFFE_UN_DX	0.00226815006929	1 E – 0 6
9	MASS_EFFE_UN_DX	0.0172850618745	1 E – 0 6

4 Modeling B

4.1 Characteristics of modeling and the grid

Even characteristic that modeling *A* , only the type of element of beam changes. In this case they are elements POU_D_EM.

4.2 Sizes tested and results

As already specified in introduction, all the results of reference are of type AUTRE_ASTER obtained with modeling POU_D_E.

The table below summarizes the results got by the orders POST_ELEM, with the keyword MASS_INER.

Sizes	Values References	Precision
MASS	5.8576E+02	1E - 06
CDG_X	2.0000E+00	1E-06
CDG_Z	2.0397E+00	1E - 06
IX_PRIN_G	1.5656E+03	1E - 06
IY_PRIN_G	1.8182E+03	1E - 06
IZ_PRIN_G	2.2349E+03	1E - 06

Mode	PARA	Value of reference	Precision
1	FREQ	9.98316178503	1 E – 0 6
2	FREQ	12.3054090119	1E–06
3	FREQ	13.0421930932	1 E – 0 6
4	FREQ	19.0267560923	1 E – 0 6
5	FREQ	22.2977469834	1 E – 0 6
6	FREQ	26.7653558109	1 E – 0 6
7	FREQ	33.6499455758	1 E – 0 6
8	FREQ	34.476790496	1 E – 0 6
9	FREQ	35.1296888165	1 E – 0 6
10	FREQ	36.8646125525	1 E – 0 6
1	MASS_EFFE_UN_DX	0.240393876317	1 E – 0 6
2	MASS_EFFE_UN_DX	0.433081172981	1 E – 0 6
3	MASS_EFFE_UN_DY	0.527057012444	1 E – 0 6
3	MASS_EFFE_UN_DZ	4.1536989003E-4	1 E – 0 6
4	MASS_EFFE_UN_DX	0.0799412335197	1 E – 0 6
5	MASS_EFFE_UN_DY	0.136506718973	1 E – 0 6
6	MASS_EFFE_UN_DY	0.0630112344329	1 E – 0 6
7	MASS_EFFE_UN_DY	6.12175711067E-4	1 E – 0 6
8	MASS_EFFE_UN_DX	1.47389085571E-3	1 E – 0 6
9	MASS_EFFE_UN_DX	0.0126681569373	1 E – 0 6

5 Modeling C

5.1 Characteristics of modeling and the grid

Even characteristic that modeling *A* , only the type of element of beam changes. In this case they are elements POU_D_TG.

5.2 Sizes tested and results

This modeling is used as reference to modeling *A* . The exploited results are the frequencies (FREQ) as well as the effective masses (MASS_EFFE_UN).

Tests of nonregression only.

6 Modeling D

6.1 Characteristics of modeling and the grid

Even characteristic that modeling *A* , only the type of element of beam changes. In this case they are elements POU_D_E.

6.2 Sizes tested and results

This modeling is used as reference to modeling *B* . The exploited results are the frequencies (FREQ) as well as the effective masses (MASS_EFFE_UN).

Tests of nonregression only.

7 Summary of the results

It is noted that for two treated modelings (POU_D_TGM and POU_D_EM), the results are very close to the values of reference.