SSLL119 – Beams subjected to moments distributed

Summarized:

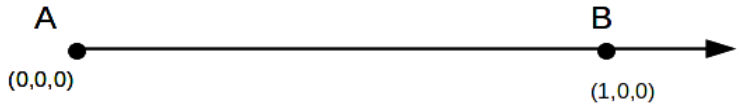
The purpose of this test is to validate the application of moments distributed on the beams.

Note: The moments distributed on the beams are affected by commands AFFE_CHAR_MECA and AFFE_CHAR_MECA_F , operand FORCE_POUTRE , key word MX, MY, MZ, MT, MFY and MFZ. They are applicable to the straight beams with constant characteristics.

1 Problem of reference

1.1 Geometry

One considers a beam length $1\,m$ directed according to X or Z following the modelizations.



1.2 Loadings

1.2.1 Boundary conditions

In each case, the node A is clamped. Then according to the type of moment tested, the node B can be either left free, or out of bearing according to a given direction.

1.2.2 Moments distributed

One applies the key word in turn MX, MY, MZ, MT, MFY and MFZ. The load is linear on beam:

Node	A	B
Value (N.m/m) 1000	1000	2000

nonconstant loadings are affected by the command AFFE_CHAR_MECA_F .
To test moments distributed affected by the command AFFE_CHAR_MECA , one supplements this list by constant loadings. Reference solution

2 Twisting moment

2.1

an analytical solution for the twisting moment is easily by a computation of Strength of materials. That is to say

the beam AB length, L embedded in, A if one applies one twisting moment in mt a point of C then $[AB]$ the resulting moment in is A . mt The reaction according to the moment is thus formula $-mt$

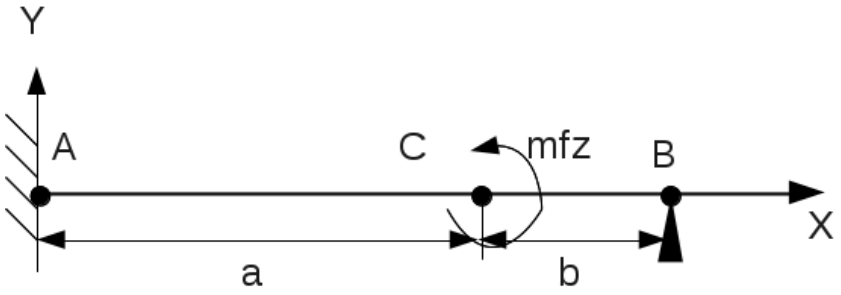
applying one linear twisting moment, distributed to the beam, equal to in mt_A and A to in mt_B , B one obtains the reaction in moment formulates M_A : A Bending moment

$$M_A=-\int_0^L mt_A+\frac{(mt_B-mt_A)}{L}x\,dx$$

$$M_A=-L\frac{(mt_A+mt_B)}{2}$$

2.2

the forms of Strength of materials provide results of reference for one moment according to applied Z to the point of C a beam AB length embedded L in and A bearing according to in Y . B formulate



$$R_A=-R_B=\frac{3\,mfz(L^2-b^2)}{2\mathrm{L}^3}$$

$$M_A=\frac{mfz(L^2-3\mathrm{b}^2)}{2\mathrm{L}^2}$$

is R_A the reaction of bearing and M_A the moment, in formula A

applying one linear bending moment, distributed to the beam, equal to formula mf_A formula A formula mf_B formula B obtains: formulate

$$R_A=-R_B=\frac{3}{2\mathrm{L}^3}\int_0^L(mf_A+\frac{(mf_B-mf_A)}{L}x)(L^2-(L-x)^2)\,dx$$

$$M_A=\frac{1}{2\mathrm{L}^2}\int_0^L(mf_A+\frac{(mf_B-mf_A)}{L}x)(L^2-3(L-x)^2)\,dx$$

gives after integration: formulate

$$R_A = -R_B = \frac{3mf_A + 5mf_B}{8}$$

$$M_A = L\frac{mf_B - mf_A}{8}$$

: If one passes in the plane with XOZ the one moment application according to, Y it is necessary to multiply the reactions par. -1 Uncertainties

2.3 on the solution None

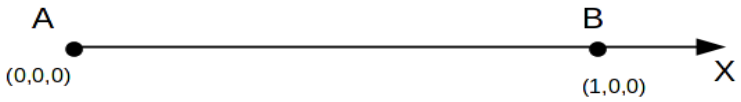
. Modelization

3 A Characteristic

3.1 of the modelization

modelizations POU_D_E , POU_D_T , POU_D_TG , POU_D_EM and POU_D_TGM are affected in turn on the mesh. Characteristics

3.2 of the mesh The mesh



consists of a mesh SEG2 .
The local coordinate system is identical to the total reference. Quantities

3.3 tested and results

the values tested are the same ones some is the modelization of beam. Twisting moment

3.3.1 distributed

the load applied in this case obtained by AFFE _CHAR_MECA_F/FORCE_POUTRE/MX or MT . Node

Field	Component	Value of reference	**Tolerance**	**(%) A**
REAC_NODA	DRX	-1500.0	0.1	Bending moment

3.3.2 distributed according to Y

the load applied in this case obtained by AFFE _CHAR_MECA_F/FORCE_POUTRE/MY or MFY . It is specified that the node is B out of bearing according to. Z Node

Field	Component	Value of reference	**Tolerance**	**(%) A**
REAC_NODA	DZ	-1625.0	0.1	A
REAC_NODA	DRY	125.0	0.1	B
REAC_NODA	DZ	1625.0	0.1	Bending moment

3.3.3 distributed according to Z

the load applied in this case obtained by AFFE _CHAR_MECA_F/FORCE_POUTRE/MZ or MFZ . It is specified that the node formula B out of bearing according to formula Y

Field	Component	Value of reference	**Tolerance**	**(%) A**
REAC_NODA	DY	1625.0	0.1	A
REAC_NODA	DRZ	125.0	0.1	B
REAC_NODA	DY	-1625.0	0.1	constant

3.3.4 Bending moment according to Y and Z

the load applied in this case obtained by AFFE _CHAR_MECA/FORCE_POUTRE/MFZ, MZ . MFY , MY , MX , MT . Next

moment, Z node formula B out of bearing according to formula Y

Field	Component	Value of reference	**Tolerance**	**(%) A**
REAC_NODA	DY	1000.0	0.1	A
REAC_NODA	DRZ	0.0.0.1		B
REAC_NODA	DY	-1000.0	0.1	next

Moment formulates Y formula B out of bearing according to formula Z

Field	Component	Value of reference	**Tolerance**	**(%) A**
REAC_NODA	DZ	-1000.0	0.1	A
REAC_NODA	DRY	0.0.0.1		B
REAC_NODA	DZ	1000.0	0.1	Modelization

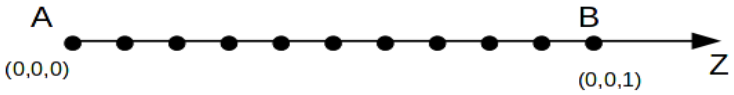
4 B Characteristic

4.1 of the modelization

modelizations POU_D_E , POU_D_T , POU_D_TG , POU_D_EM and POU_D_TGM are affected in turn on the mesh. Characteristics

4.2 of the mesh The mesh

consists of 10 meshes SEG2 . One



specifies the correspondence between the local coordinate system and the total reference: Local coordinate system

Locates	Z total
X	there
Y	Z
- X	Quantities

4.3 tested and results

the values tested are the same ones some is the modelization of beam. Twisting moment

4.3.1 distributed

the load applied in this case obtained by AFFE _CHAR_MECA_F/FORCE_POUTRE/MZ or MT . Node

Field	Component	Value of reference	**Tolerance**	**(%) A**
REAC_NODA	DRZ	-1500.0	0.1	Bending moment

4.3.2 distributed according to Y

the load applied in this case obtained by AFFE _CHAR_MECA_F/FORCE_POUTRE/MY or MFY . It is specified that the node formula B out of bearing according to formula X

Field	Component	Value of reference	**Tolerance**	**(%) A**
REAC_NODA	DX	1625.0	0.1	A
REAC_NODA	DRY	125.0	0.1	B
REAC_NODA	DX	-1625.0	0.1	Bending moment

4.3.3 distributed according to X

the load applied in this case obtained by AFFE _CHAR_MECA_F/FORCE_POUTRE/MX or MFZ . It is specified that the node formula B out of bearing according to formula Y

Field	Component	Value of reference	**Tolerance**	**(%) A**
REAC_NODA	DY	1625.0	0.1	A
REAC_NODA	DRX	-125.0	0.1	B
REAC_NODA	DY	-1625.0	0.1	Summary

5 of the results For

each treated modelization, the results are very close to the analytical solution. This validates the use of moments distributed in Code_Aster .