# Modelings POU_D_TG, POU_D_TGM

**Summary:**

This document describes for modelings POU_D_TG and POU_D_TGM :
- degrees of freedom carried by the finite elements which support modeling,
- the related meshs supports,
- supported loadings,
- nonlinear possibilities,
- CAS-tests implementing modelings

Modeling POU_D_TG to a formulation of elements of beams of take Timoshenko into account a modeling of the warping of the section (cf [R3.08.03] corresponds).

Modeling POU_D_TGM be based on the same formulation and allows to take into account a nonlinear behavior of multifibre type.

They are usable for problems of beams in isotropic linear mechanical analysis and elastoplasticity.

# Contents

# 1 Discretization

## 1.1 Degrees of freedom

The degrees of freedom are, in each node of the mesh support, the six components of displacement (three translations and three rotations) more one component (GRX) relating to the warping of the section compared to neutral fibre (cf [R3.08.03]).

| Finite element | Degrees of freedom (with each node top) | | | | | | |
|---|---|---|---|---|---|---|---|
| POU_D_TG | DX | DY | DZ | DRX | DRY | DRZ | GRX |
| | | | | | MARTINI | | |

## 1.2 Mesh support of the matrices of rigidity

The meshs support of the finite elements, in displacement formulation, are segments with two nodes SEG2 :

| Modeling | Mesh | Finite element | Remarks |
|---|---|---|---|
| POU_D_TG | SEG2 | MECA_POU_D_TG | |
| POU_D_TGM | SEG2 | MECA_POU_D_TGM | |

# 2 Assignment of the characteristics

For these elements of structures 1D, it is necessary to affect geometrical characteristics which are complementary to the data of grid. The definition of these data is carried out with the order AFFE_CARA_ELEM associated with the keywords following factors:

- **BEAM**
  Allows to define and affect the characteristics of the cross section.
  Supported modelings: POU_D_TG, POU_D_TGM
- **ORIENTATION**
  Allows to lay and affect down the direction of the main axes of inertia around neutral fibre.
  Supported modelings: POU_D_TG, POU_D_TGM

# 3 Supported loadings

Loadings specific, available in AFFE_CHAR_MECA are the following:

- **CONTACT**
  Allows to define the zones subjected to conditions of contact.
  Supported modelings: POU_D_TG, POU_D_TGM

- **EPSI_INIT**
  Allows to apply a loading of initial deformation.
  Supported modeling: POU_D_TG

- **FORCE_POUTRE**
  Allows to apply linear forces
  Supported modelings: POU_D_TG, POU_D_TGM

- **GRAVITY**
  Allows to apply a loading of type gravity.
  Supported modelings: POU_D_TG, POU_D_TGM

# 4 Non-linear possibilities

## 4.1 Laws of behaviors

Laws of behaviors specific to these modelings, usable under BEHAVIOR in STAT_NON_LINE and DYNA_NON_LINE are the following ones (cf [U4.51.11]):

/ **'VMIS_CINE_LINE'**
Supported modeling: POU_D_TGM

/ **'VMIS_ISOT_LINE'**
Supported modeling: POU_D_TGM

/ **'VMIS_ISOT_TRAC'**
Supported modeling: POU_D_TGM

/ **'GRAN_IRRA_LOG'**
Supported modeling: POU_D_TGM

**Note:**
*It is also possible for these modelings using a monodimensional state of stresses to use the behaviors 3D (thanks to the method of Borst [R5.03.03]).*

## 4.2 Deformations

Deformations available, used in the relations of behavior under the keyword DEFORMATION for the operators STAT_NON_LINE and DYNA_NON_LINE are (cf [U4.51.11]):

/ **' SMALL '**
The deformations used for the relation of behavior are the linearized deformations.

/ **' PETIT_REAC '**
The increments of deformations used in the incremental relation of behavior are the linearized deformations of the increment of displacement in the reactualized geometry.

**Note:**
*Attention, the calculation of the deformations using PETIT_REAC is only one approximation of the assumption of great displacements. It requires to carry out very small increments of loading. To correctly take into account great displacements, and especially great rotations, it is recommended to use modeling POU_D_T_GD .*

# 5 Examples of implementation: CAS-test

- **POU_D_TG**
  - Linear statics
    SSLL102D [V3.01.102]: Analysis of a beam fixed at an end and subjected to unit efforts at the other end.
  - Linear dynamics
    SDLL01B [V2.02.01]: Research of the frequencies of vibration and the modes associated with a short beam on simple supports.

- **POU_D_TGM**
  - Non-linear statics
    SSNL122A [V6.01.122]: Analysis of a beam multifibre embedded at an end and subjected to a force at the other end.
    SSNL106A [V6.02.106]: Analysis of a right beam embedded at an end and subjected to a displacement in traction and inflection at the other end, with a law of elastoplastic behavior or linear work hardening.
  - Linear dynamics
    SDLL132A [V2.02.132]: Research of the frequencies of vibration and the associated clean modes of a frame.
  - Non-linear dynamics
    SSNL106I [V6.02.106]: Analysis of a right beam embedded at an end and subjected to a displacement in traction and inflection at the other end, with a law of elastoplastic behavior or linear work hardening. The analysis was carried out with the nonlinear operator of dynamics.