SDNV138 – Deadened dynamic response joints of stud of stoppings

Summary:

One studies the deadened dynamic response of joints between studs of stopping maintained by an internal compressive force horizontal then subjected to a seismic request of the same direction causing of separations then rebounds of the studs one on the other. The behavior of three-dimensional joints, affected of material is tested JOINT_MECA_FROT, with modeling 3D_JOINT.

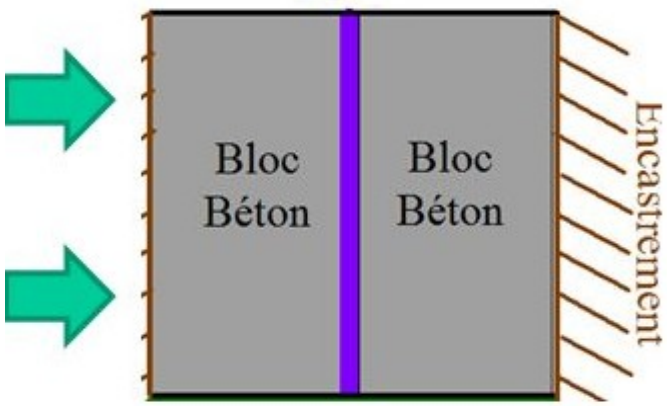
One makes tests of NON_REGRESSION on Lbe values of maximum horizontal displacement of edge of stud at the time of the rebounds.

1 Problem of reference

1.1 Geometry and loading

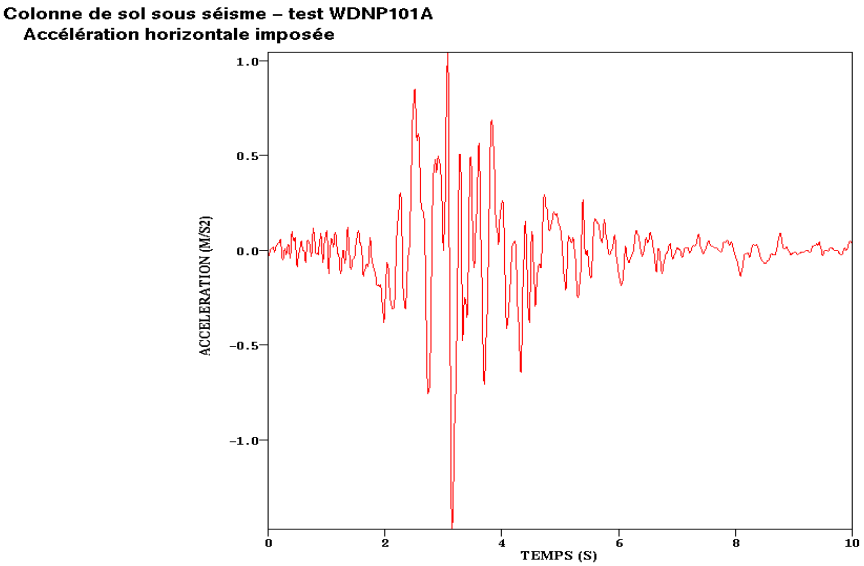
One considers two studs of stopping, represented by regular cubes length $L=5\mathrm{m}$, height $H=10\mathrm{m}$ and depth $P=1\mathrm{m}$. The distance between the studs is supposed nonworthless to simplify the generation of the grid of the joints ($\varepsilon=1\mathrm{mm}$). Embedding varies according to modelings.

The right side of the stud is embedded, while one applies a force imposed to the left side of the stud corresponding to horizontal gravity being worth $0.1\,G$ who causes to crush the left block on the right block by putting in compression the vertical line of joints.



Drawing 1: Modeling A

One subjects then the unit to an imposed horizontal acceleration resulting from a realistic earthquake used already in the test WDNP101A, of maximum amplitude $0.15\,G$ and which causes to make take off then to rebound the left block compared to the right block when the level of acceleration exceeds $0.1\,G$. The pace of the imposed signal is represented on the figure below:



Drawing 2: Imposed seismic signal

1.2 Properties of material

The values of the mechanical parameters of the studs (Young modulus, Poisson's ratio, voluminal density) are in the following way selected:

$$E=3.10^{10}\,Pa \qquad \nu=0,25 \qquad \rho_b=2400\,kg/m^3$$

1.2.1 Material JOINT_MECA_FROT

For the law of friction associated with the joint, one chooses realistic values but which do not correspond to a material in particular.

$$K_N=K_T/2=10^{12}\,Pa/m \qquad Amornor=100\,MPa.s/m \qquad Amortan=10\,MPa.s/m$$

$$\mu=0.35 \qquad \text{adhe}=0 \qquad \text{ecrouissage}=0.1\,K_T$$

2 Reference solution

One makes tests of NON_REGRESSION on Lbe values of maximum displacement of edge of stud at the time of the rebounds of the studs one on the other.

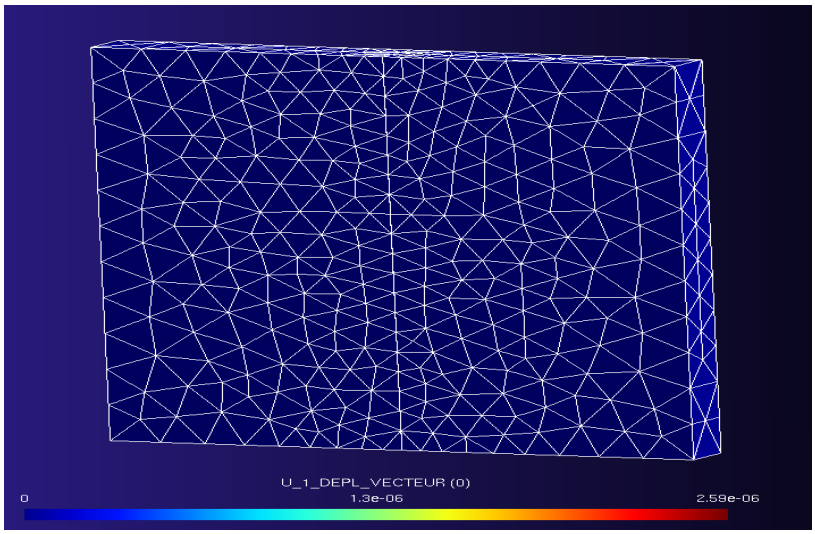
3 Modeling A

3.1 Characteristics of modeling

Simulation is carried out with modeling 3D_JOINT. The elements are of type TETRA4 for the studs and PENTA6 for the elements of joint. The corresponding law of behavior is JOINT_MECA_FROT, the associated material bears the same name. The voluminal elements are elastic.

3.2 Characteristics of the grid

One carries out a linear grid not structured (figure below).
Voluminal elements (studs): 2761 TETRA4
Elements of joint: 92 PENTA6



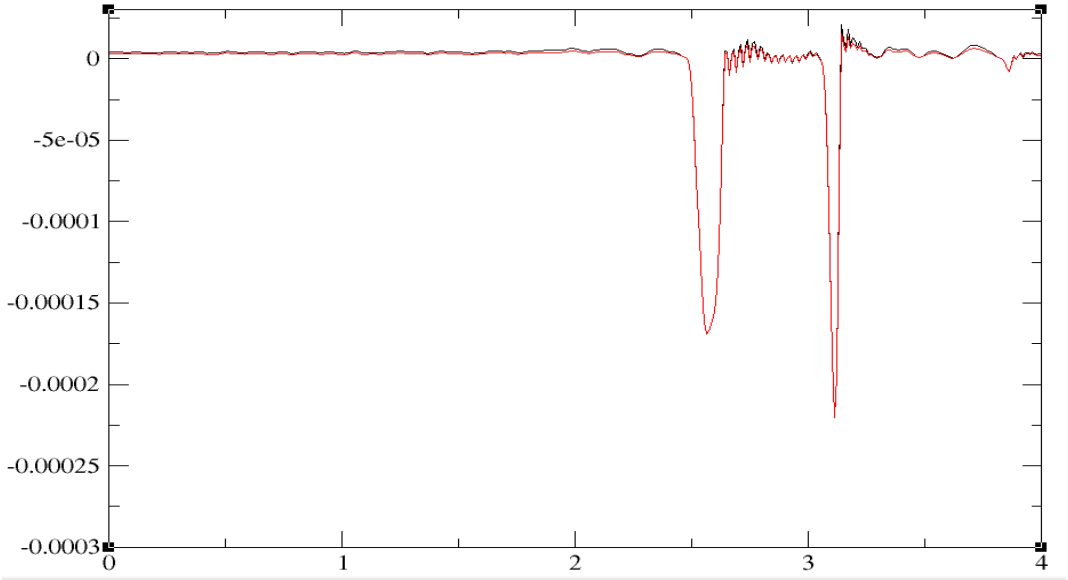
Drawing 3: Grid 3D

3.3 Calculation of the answer to the seismic request

The calculation of the answer to the seismic request takes place over one duration of 4 second sufficient for obtaining principal maximum. The step of common time for calculation and filing is of 0.01 second is 400 pas in all.
For dynamic calculation, one uses an implicit method of resolution with the method HHT .

3.4 Sizes tested and results

One tests the horizontal displacement of a node of the edge of the left block of studs, in particular the maximum amplitudes obtained at the time of the rebounds of a stud on the other at the time of the earthquake. The general pace of the evolution of such a displacement (in meters) compared to time (in seconds) is represented on the figure below:



Drawing 4: Transitory evolution of the horizontal displacement of the left edge of stud

The maximum values of displacement of a node of edge of the left stud at the time of the earthquake are the object of tests of not-regression:

Identification	Type of reference	Tolerance
$UX\ N1 - t = 2{,}56\,s$	'NON_REGRESSION'	0.0001%
$UX\ N1 - t = 3{,}11\,s$	'NON_REGRESSION'	0.0001%

4 Summary of the results

Lbe values obtained maximum displacement of edge of stud at the time of the rebounds of the studs one on the other are the object of tests of not-regression. It is noted qualitatively that the phases of rebound maximum correspond rather well to the moments when the level of acceleration of training imposed exceeds the level of acceleration $0.1\,G$ of static horizontal gravity initially forced in order to crush the left block on the right block by putting in compression the vertical line of joints.