ZZZZ402 - Validation use of POST_NEWMARK

Summary:

This test validates the use of order POST_NEWMARK.

Modeling a: simulation of the seismic answer and calculation of residual displacements of a work in fill in elasticity with DYNA_VIBRA in transitory temporal calculation.

Modeling B: simulation of the seismic answer and calculation of residual displacements of a work in fill with the law of Iwan via DYNA_NON_LINE.
1 Problem of reference

1.1 Geometry

One considers a stopping in fill and a circle of theoretical slip possible, of which the main features are described below:

![Figure 1 Configuration work in fill and positioning of the circle of slip.](image)

1.2 Properties of materials

1.2.1 Elastic properties of material

Mechanical characteristics of materials model which was used are summarized in Table 1.1 - below:

<table>
<thead>
<tr>
<th>Material</th>
<th>$v_s$ (m/s)</th>
<th>$E$ (Pa)</th>
<th>$\rho$ (kg/m$^3$)</th>
<th>$\nu$</th>
<th>$\xi$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOPPING</td>
<td>305</td>
<td>$5 \times 10^8$</td>
<td>1800</td>
<td>0.49</td>
<td>2.0</td>
</tr>
<tr>
<td>ROCK</td>
<td>2700</td>
<td>500 $10^8$</td>
<td>2300</td>
<td>0.48</td>
<td>2.0</td>
</tr>
</tbody>
</table>

1.3 Boundary conditions and loadings mechanical

1.3.1 Boundary condition

Boundary conditions applied with the model are the following ones:

- *LowE and flat rims and left of the foundation*: Assignment Dbe elementS of absorbing border.

1.3.2 Loading

Loading of the type **ONDE PLANE** of type S following a vertical propagation (**DIRECTION= (0,1,0)**) applied to the base of the foundation.

LE signal in acceleration being used for calculation of the loading is presented in Figure 2.
1.4 Conditions initial

Displacement is null in the whole of the model at the initial moment.

1.5 Position of the circle of slip

The center of the circle of slip is positioned with the coordinate \((80, 220)\), with a ray of \(50\ m\). The value of \(k_y\) is fixed at \(0.001\), the critical acceleration being thus of \(a_y = 0.00981\ m/s^2\).
2 Reference solution

The reference solution of modeling A is a test of nonregression.

Modeling A is taken into account like reference of calculation for modeling B.
3 Modeling A

3.1 Characteristics of modeling

Modeling With use a model of behavior for stopping of the linear type, calculation being carried out starting from the operator DYNA_VIBRA on physical basis into temporal, with a temporal diagram of integration of Newmark not deadened ($\beta=0.25$ and $\gamma=0.5$) and a modal damping reduced by 0.01 %.

One uses for modeling With the definition of the circle starting from the keyword RAY, CENTRE_X and CENTRE_Y like starting from an auxiliary grid 2D sufficiently refined same circle using the keyword MAILLAGE_GLIS.

3.2 Sizes tested and results

One tests value of irreversible displacement at various moments estimated by the method of Newmark.

<table>
<thead>
<tr>
<th>Identification</th>
<th>Type of reference</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>t=0.6 S</td>
<td>‘NON_DEFINI‘</td>
<td>0.001%</td>
</tr>
<tr>
<td>T=0.9 S</td>
<td>‘NON_DEFINI‘</td>
<td>0.001%</td>
</tr>
</tbody>
</table>
4 Modeling B

4.1 Characteristics of modeling

Modeling With use it model of behavior of Iwan for the stopping. Calculation is carried out starting from the operator DYNA_NON_LINE. Nevertheless, the loading is sufficiently small so that one can use the results of the elastic design of modeling A as reference solution for modeling B. One considers a temporal diagram of integration of Newmark not deadened (β=0.25 and γ=0.5).

4.2 Sizes tested and results

One tests value of irreversible displacement at various moments estimatedE by the method of Newmark.

<table>
<thead>
<tr>
<th>Identification</th>
<th>Type of reference</th>
<th>Value of reference</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>t=0,6 S</td>
<td>'AUTRE_ASTER'</td>
<td>9.44055232681E-05</td>
<td>0.001%</td>
</tr>
<tr>
<td>T=0.9 S</td>
<td>'AUTRE_ASTER'</td>
<td>0.000228145272925</td>
<td>0.001%</td>
</tr>
</tbody>
</table>
5 Summary of the results

Figures 3.4 and 5 have the result of the calculation of the method of Newmark available in the concept counts resulting from the macro-order.

![Figure 3 – Average acceleration along the critical acceleration and rough surface](image3.png)

![Figure 4 – Integration of the average acceleration exceeding the accélérative ration](image4.png)
These results show the control volume POST_NEWMARK to consider displacement irreversible at the time of an earthquake of a work in fill by the method of Newmark, for a linear dynamic modeling temporal or non-linear.