

SDLV133 - Harmonic resolution of a cylinder of ground dug in a homogeneous medium semi - infinite

Summary:

This test takes part of the checking of the chaining *Code_Aster* - MISS3D. It represents a standard case of test of depression of a structure in a ground where the harmonic resolution is made in *Code_Aster* after extraction of impedances of ground calculated by MISS3D. This test has a heterogeneity of modeling in a half - infinite space of ground of which a part, made up of a cylinder full ray and height $4 m$, is modelled by *Code_Aster*. The rest of the ground is modelled by MISS3D. One compares the answer in 3 levels of depth of ground calculated by *Code_Aster* with the incidental field calculated by MISS3D on these same levels.

The agreement is very correct between the results of the test and the references.

1 Problem of reference

1.1 Geometry

Software MISS3D uses the frequential method of coupling to take account of the interaction ground - structure. This method, based on the dynamic under-structuring, consists in cutting out the field of study in three under-fields:

- ground,
- the foundation,
- the structure.

Ground

The ground corresponds to a semi-infinite homogeneous medium.

The foundation

The surface foundation of the cylinder of ground is represented on [Figure 1.1-a] below. To the initial surface model of 64 elements representing the base of the foundation, one adds 64 surface elements to represent the side walls of the depression of $4 m$.

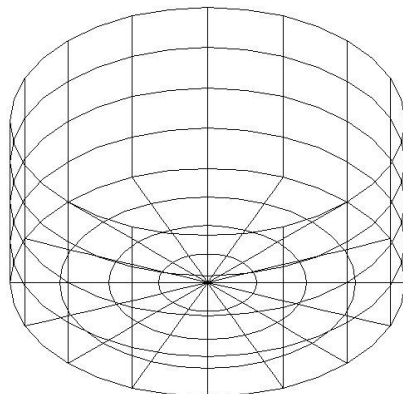


Figure 1.1-a: Surface grid of the foundation

The structure

The structure consists of solid elements representing a cylinder full with $4 m$ of height and $4 m$ of ray dug in the ground semi - infinite.

1.2 Properties of materials

Ground

The mechanical characteristics of the layers of the model of ground which were used are those indicated below which make it possible to obtain a speed of wave of shearing of 336 m/s .

E	5.419008 E8
NAKED	0.2
RHO	2000.
AMOR_HYST	0.1

The foundation and the structure

The mechanical characteristics of the foundation and the structure which were used are the same ones as those of the ground described above.

1.3 Boundary conditions and loadings mechanical

To calculate the constrained static modes of foundations and the clean modes, one blocks the 3 degrees of freedom of translation of all the nodes of the foundation. One imposes then seismic incidental forces equivalent to a movement of acceleration imposed on the surface of the structure, either unit harmonic, or transient starting from a temporal signal.

Transitory acceleration in the ground with the dimension 0 m for the 2 horizontal directions X and Y is resulting from a spectrum NUREG normalized with 0.3 g with a stage with 0.6 g enter 2 and 10 Hz .

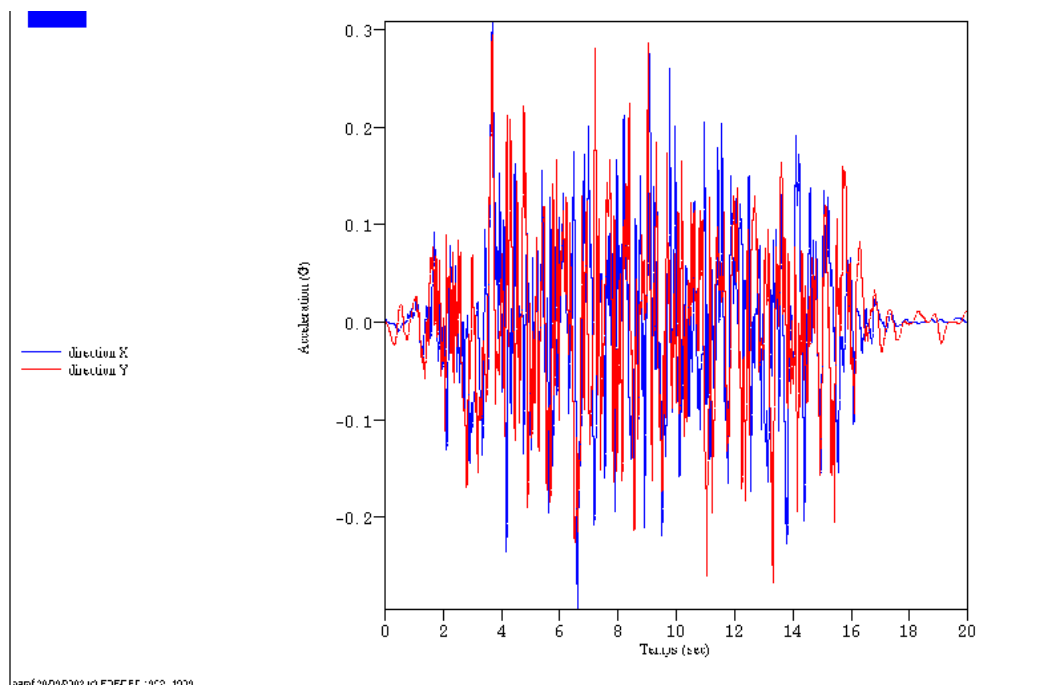


Figure 1.3-a: Accélérogrammes directions X and Y

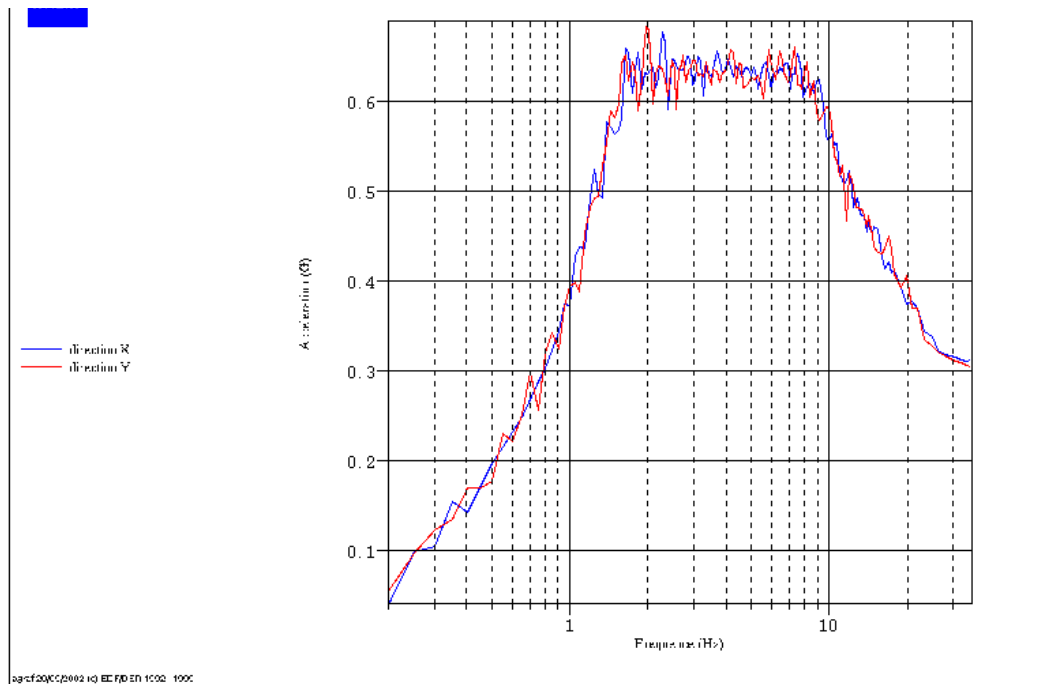


Figure 1.3-b: Spectra Nureg 5% directions X and Y

2 Reference solution

2.1 Method of calculating used for the reference solution

The results of reference are the evolutions of the incidental fields obtained by the computation software of interaction ground - structure MISS3D in various levels of depth of a medium semi - infinite by considering the unit and constant incidental field compared to the frequency of request. The variation of this field in the depth of the medium semi - infinite, or déconvolution, is obtained starting from functions of Green, which constitute a base of elementary solutions in various receiving levels with unit requests in various levels sources of the ground [bib1].

2.2 Results of reference

For obtaining results of reference, one bases oneself on the incidental field obtained in 3 levels of depth in the ground:

- on level A on the surface of the ground (at the top of the cylinder),
- on the level B with a depth of 2 m (in the middle of the cylinder),
- on the level C with a depth of 4 m (at the base of the cylinder).

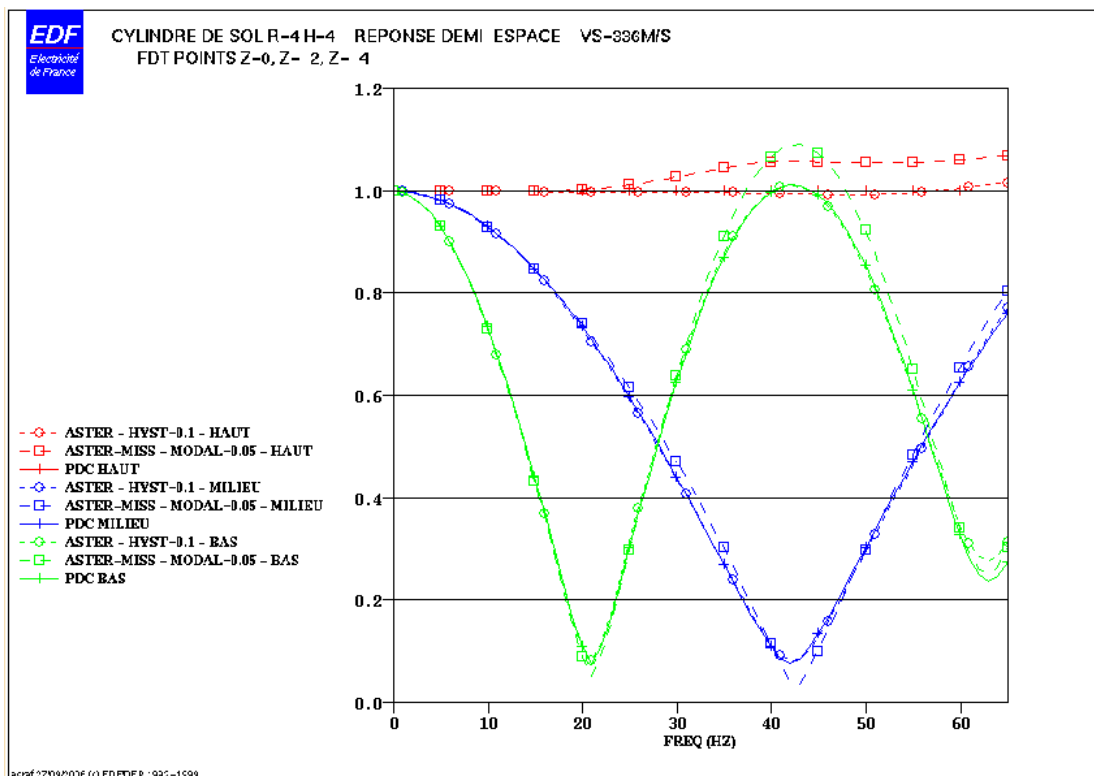


Figure 2.2-a: Transfer functions transfer harmonic in 3 levels - direction X

2.3 Bibliographical references

1. D. CLOUTEAU: "Manual of reference of MISS3D – version 6.3 – Power station Searches SA"

3 Modeling A

3.1 Characteristics of modeling

The characteristics used and the grid are those deduced from the data of [§1]. For the harmonic answer and obtaining transfer transfer functions in various levels of ground, one uses a range of frequencies of calculation enters 21 and 42 Hz by step of 21 Hz to accelerate calculations.

3.2 Characteristics of the grid

Grid provided to Aster contains quadratic elements of type HEXA20 to model the structure and quadratic elements of types QUAD8, TRIA6 to model the foundation. It is important to have directed the elements of surface of the foundation with normal returning in the ground. The meshes of the side walls representing the depression are generated by the same vertical generator as MISS3D requires it. One obtains in all 192 meshes HEXA20 and 64 meshes PENTA15 for the structure and 128 elements surface for the foundation.

3.3 Sizes tested and results

The values tested below correspond to the figure [fig2.2-a].

Identification
<i>UXA (21 Hz)</i>
<i>UXA (42 Hz)</i>
<i>UXB (21 Hz)</i>
<i>UXB (42 Hz)</i>
<i>UXC (21 Hz)</i>
<i>UXC (42 Hz)</i>

4 Summary of the results

The agreement enters the maximum ones of the transfer transfer functions obtained in 3 levels of the cylinder of ground respectively by *Code_Aster* and MISS3D is of as much better than the structure is modelled by quadratic elements and than one uses for the structure same damping hysteretic as the ground rather than a modal damping are equivalent.