FORMA40 - Practical works - training “Civil engineer”: study of a plate comforts subjected to gravity and bending

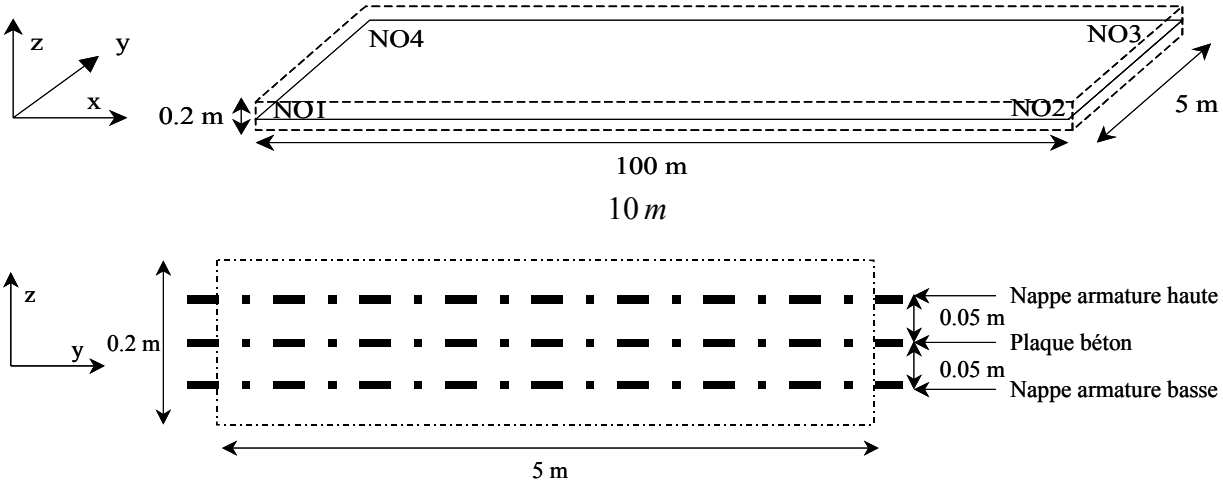
Summarized:

This test is a test making it possible to begin with computations in Civil engineer. The purpose of it is representing a plate comforts out of reinforced concrete modelled, either using a modelization of plate, or by a modelization 3D , and initiating themselves with postprocessings.

1 Problem of reference

1.1 Geometry

One seeks to model a reinforced concrete cantilever of dimension $10\text{m}\times 5\text{m}\times 0{,}2\,m$ having two three-dimensions functions of reinforcements inserted in the concrete with $5\,cm$ coating.



1.2 Properties of the materials

steels and the concrete are supposed to be elastic.

Comfort out of concrete: $E=3\times 10^{10}\,Pa$ $\nu=0{,}2$, $\rho=2500\,kg/m^3$

of the cantilever formulates: $0.2\,m$;

Three-dimensions functions of steel reinforcement: $E=2\times 10^{11}\,Pa$, $\nu=0{,}3$, $\rho=7800\,kg/m^3$

high Three-dimensions function of reinforcements: section per linear meter = $0.2\,m^2/ml$;

eccentring = $0.05\,m$;

Low three-dimensions function of reinforcements: section per linear meter = $0.2\,m^2/ml$;

eccentring = $-0.05\,m$;

1.3 Boundary conditions and loadings

the boundary conditions and the loadings break up in the following way:
Initially (enters $t=0$ and $t=1$):

- Edge $NO1NO4$ ($B0X$) clamped and edge $NO2NO3$ ($B1X$) blocked according to Z
- Gravity

In the second time (between $t=1$ and $t=2$) one applies:

- $DZ=-0,1\,m$ on edge $NO2NO3$ ($B1X$) (loading of bending)

2 Reference solution

It acts of a test inspired of benchmark SSLS132.
The values of reference are only values of NON-regression.

3 Modelization A

3.1 Unfolding of the TP

It acts to carry out computation and the by modelling the concrete using 3D elements steel reinforcements with elements GRILLE_MEMBRANE. The command file *Code_Aster* will be generated using *Eficas*.

3.2 Realization of the mesh

The mesh could be carried out with *Salomé*. One suggests here defining surfaces explicitly where the three-dimensions functions of reinforcements will be located.
If need, the mesh with med format is provided.

3.3 Elastic design

One will define in the command file, using Eficas launched in Salomé the various commands necessary to the realization of this study. The various stages are indicated below:

To see the mesh with med format (LIRE_MAILLAGE);
To create the meshes associated ones with the three-dimensions functions with reinforcements (CREA_MAILLAGE);
To define the properties material of steel and concrete (DEFI_MATERIAU/ ELAS then AFFE_MATERIAU);
To assign the modelizations to various mesh groups (AFFE_MODELE/3D and GRILLE_MEMBRANE);
To define the characteristics of the structural elements (key word GRILL for elements GRILLE_MEMBRANE)
To define the boundary conditions and the loadings (key word DDL_IMPO and PESANTEUR under AFFE_CHAR_MECA). One proposes to impose the loading of bending in the second time. What requires to define a multiplying function using command DEFI_FONCTION ;
To create the temporal discretization using DEFI_LIST_REEL.
To use STAT_NON_LINE for the elastic design (COMP_INCR/RELATION=' ELAS') with the list of time defined previously.
To print result with med format (IMPR_RESU/FORMAT=' MED')
Launching computation

3.4 Postprocessing

3.4.1 basic Examination with *Paravis*

To import med file in *Salome* under *Paravis*.
To trace the deformed shape (filter *Warp by Vector*).
To visualize the stresses with Gauss points.
To supplement the command file by calculating various interesting quantities: strains (type ELGA or ELNO), stresses and/or strains equivalent. To start again computation then to visualize the various quantities under *Salomé*.

3.4.2 To trace curved force-displacement in *Code_Aster*

By taking again the initial command file or in a new file in POURSUITE, to make postprocessings allowing to trace curved force-displacement.

to calculate the nodal forces using command CALC_CHAMP ;
to recover the resultant of the forces applied using command POST_RELEVE_T ;
to recover the following displacement Z of edge *NO2NO3* using command POST_RELEVE_T ;
to print the two arrays to visualize the contained information;
to trace curved force-displacement with format XMGRACE using command IMPR_FONCTION. For that to recover the functions to be traced using RECU_FONCTION by applying the filters necessary. (Not to forget to specify the unit and to add an output file in ASTK, to be able to visualize the curve directly).

3.4.3 Suggestions of other postprocessings

line To recover the strains along one (for example of the point $(0,2.5,0)$ at the point $(100.,2.5,0)$ using command MACR_LIGN_COUP. To print the curve using command IMPR_TABLE.
To print the maximum stress obtained in the concrete then in steels using command POST_RELEVE_T (OPERATION=' EXTREMA').

3.5 Quantities tested and Value

results of the components of stresses:

Localization	Identification	Reference	Tolerance
Edge $B1X$	Resulting force DZ	$3{,}16529\times10^{5}$	0,001 %
	Maximum stress in the concrete	$1{,}61016\times10^{6}$	0,001 %
	Maximum stress in the steel three-dimensions function B ACP	$2{,}70282\times10^{7}$	0,001

4 % Modelization

4.1 Unfolding of the TP

It acts by means of to lead computation only structural elements to knowing elements DKT for the concrete and of elements GRILL for reinforcements, by generating the command file *Code_Aster* using *Eficas.*

4.2 Elastic design

One will define in the command file, using *Eficas* launched in *Salomé,* the various commands necessary to the realization of this study. The various stages are indicated below.

To see the mesh with med format (LIRE_MAILLAGE).
To create the meshes associated ones with the three-dimensions functions with reinforcements (CREA_MAILLAGE).
To define the properties material of steel and concrete (DEFI_MATERIAU/ ELAS then AFFE_MATERIAU).
To assign the modelizations to various mesh groups (AFFE_MODELE/ DKT and GRILLE_EXCENTREE).
To define the characteristics of the structural elements (key word COQUE for the concrete modelled by DKT, key word GRILL for elements GRILLE_EXCENTREE).
To affect the boundary conditions and the loadings (key word DDL_IMPO and PESANTEUR under AFFE_CHAR_MECA).
To create the temporal discretization using DEFI_LIST_REEL.
To use STAT_NON_LINE for the elastic design (COMP_INCR/RELATION=' ELAS') with the list of time defined previously.
To print result with med format (IMPR_RESU/FORMAT=' MED').
To launch computation.

4.3 Postprocessing

Post-to treat desired information, as for the case 3D .

4.4 Quantities tested and Value

results of the components of stresses:

Localization	Identification	Reference	Tolerance
Edge $B1X$	Resulting force DZ	$2{,}95443\times10^{5}$	0,001
	Maximum stress in the concrete	$2{,}88427\times10^{6}$	0,001
	Maximum stress in the steel three-dimensions function ACP	$2{,}44314\times10^{7}$	0,001

Note:: it is also possible to carry out this study explicitly by netting reinforcements. In this case, the mesh of reinforcements must use the same nodes as the concrete.