FORMA40 - Practical works - formation “Génie Civil”: study of a plate comforts subjected to gravity and the inflection

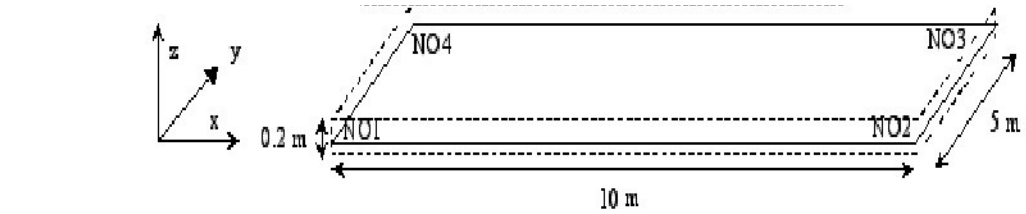
Summary:

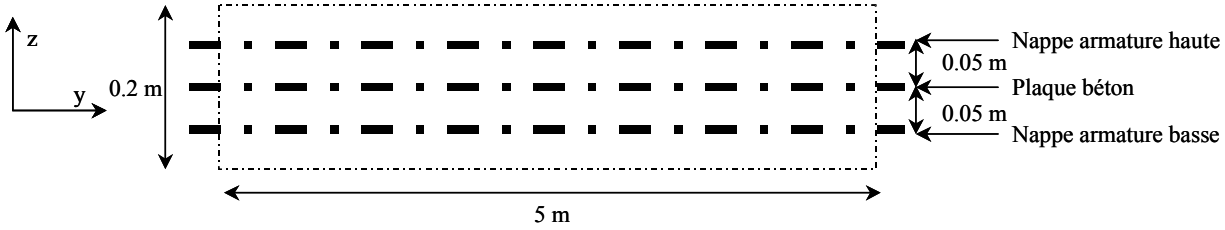
This test is a test making it possible to begin with calculations as a Génie Civil. The purpose of it is to represent a plate comforts out of reinforced concrete modelled, that is to say using a modeling of plate (modeling B) , that is to say by a modeling 3D (modeling A), and to initiate itself with postprocessings.

1 Problem of reference

1.1 Geometry

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





1.2 Properties of materials

Steels and the concrete are supposed to be elastic.

Concrete console: $E=3\times 10^{10}\,Pa$, $\nu=0{,}0$ to compare with modeling hull, $\rho=2500\,kg/m^3$

Thickness of the console: $0.2\,m$;

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

High tablecloth of reinforcements: section per linear meter = $0.2\,m^2/ml$;
offsetting = $0.05\,m$;
Low tablecloth of reinforcements: section per linear meter = $0.2\,m^2/ml$;
offsetting = $-0.05\,m$;

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

The second time (enters $t=1$ and $t=2$) one applies:
- $DZ=-0{,}1\,m$ on the edge $NO2NO3$ ($B1X$) (loading of inflection)

2 Reference solution

It is about a test inspired of CAS-test SSLS132.
The values of reference are only values of not-regression.

3 Modeling A

3.1 Unfolding of the TP

It is a question of carrying out calculation by modelling the concrete using elements 3D and them steel reinforcements with elements GRILLE_MEMBRANE. The command file *Code_Aster* will be generated using*Eficas*.

3.2 Realization of the grid

The grid could be carried out with *Salomé*. One suggests here defining surfaces explicitly where the tablecloths of reinforcements will be located.
If need be, the grid with format MED is provided.

3.3 Elastic design

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

To see it grid with format MED (LIRE_MAILLAGE);
To create the meshs associated with the tablecloths with reinforcements (CREA_MAILLAGE);
To define the properties material of steel and the concrete (DEFI_MATERIAU/ ELAS then AFFE_MATERIAU);
To assign modelings to the various groups of meshs (AFFE_MODELE/3D and GRILLE_MEMBRANE);
To define the characteristics of the elements of structures (keyword GRID for the elements GRILLE_MEMBRANE)
To define the boundary conditions and the loadings (keyword DDL_IMPO and GRAVITY under AFFE_CHAR_MECA). One proposes to impose the loading of inflection in the second time. What requires to define a multiplying function using the order DEFI_FONCTION ;
To create the temporal discretization using DEFI_LIST_REEL.
To use STAT_NON_LINE for the elastic design (COMPORTEMENT/RELATION=' ELAS') with the list of moment defined previously.
To print the result with format MED (IMPR_RESU/FORMAT=' MED')
To launch calculation

3.4 Postprocessing

3.4.1 Basic examination with *Paravis*

To import file MED in *Salomé* under *Paravis.*
To trace the deformation (filter *Warp by Vector*).
To visualize the constraints at the points of Gauss.
To supplement the command file by calculating various interesting sizes: deformations (standard ELGA or ELNO), equivalent constraints and/or deformations. To start again calculation then to visualize the various sizes under *Salomé*.

3.4.2 To trace curved force-displacement in *Code_Aster*

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

to calculate the nodal forces using the order CALC_CHAMP ;
to recover the resultant of the efforts applied using the order POST_RELEVE_T ;
to recover following displacement Z edge *NO2NO3* using the order POST_RELEVE_T ;
to print the two tables to visualize the contained information;
to trace curved force-displacement with format XMGRACE using the order 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

To recover the deformations along a line (for example of the point $(0,2.5,0)$ at the point $(10.,2.5,0)$ using the order MACR_LIGN_COUP. To print the curve using the order IMPR_TABLE.
To print the maximum constraint obtained in the concrete then in steels using the order POST_RELEVE_T (OPERATION=' EXTREMA').

3.5 Sizes tested and results

Value of the components of constraints:

Localization	Identification	Reference	Tolerance
Edge $B1X$	Resultant effort DZ	$3{,}16529\times10^{5}$	0,001 %
	Maximum constraint in the steel tablecloth ACM	$2{,}70282\times10^{6}$	0,001 %
	Maximum constraint in the concrete	$1{,}61016\times10^{7}$	0,001 %

4 Modeling B

4.1 Unfolding of the TP

It is a question of leading calculation by using only elements of structures to knowing the elements DKT for the concrete and elements GRID for the 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,* various orders necessary to the realization of this study. The various stages are indicated below.

To see it grid with format MED (LIRE_MAILLAGE).
To create the meshs associated with the tablecloths with reinforcements (CREA_MAILLAGE).
To define the properties material of steel and the concrete (DEFI_MATERIAU/ ELAS then AFFE_MATERIAU).
To assign modelings to the various groups of meshs (AFFE_MODELE/ DKT and GRILLE_EXCENTREE).
To define the characteristics of the elements of structures (keyword HULL for the concrete modelled by DKT, keyword GRID for the elements GRILLE_EXCENTREE) .
To affect the boundary conditions and the loadings (keyword DDL_IMPO and GRAVITY under AFFE_CHAR_MECA).
To create the temporal discretization using DEFI_LIST_REEL.
To use STAT_NON_LINE for the elastic design (COMPORTEMENT/RELATION=' ELAS') with the list of moment defined previously.
To print the result with format MED (IMPR_RESU/FORMAT=' MED') .
To launch calculation.

4.3 Postprocessing

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

4.4 Sizes tested and results

Value of the components of constraints:

Localization	Identification	Reference	Tolerance
Edge BIX	Resultant effort DZ	$2{,}95443\times10^{5}$	0,001 %
	Maximum constraint in the steel tablecloth ACM	$2{,}88427\times10^{6}$	0,001 %
	Maximum constraint in the concrete	$2{,}44314\times10^{7}$	0,001 %

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