PLEXU05 – Prestressed reinforced concrete plate under uniform pressure with the law GLRC_DAMAGE

Summary:

The purpose of this test is to validate the chaining of a calculation of setting in tension of a cable of prestressed in *Code_Aster* with a fast calculation of dynamics in Europlexus via the macro-order of *Code_Aster* CALC_EUROPLEXUS, and in the presence of the law of behavior GLRC_DAMAGE.

More precisely, it validates the following points:

- good transmission of information of the law GLRC_DAMAGE of *Code_Aster* towards Europlexus via the macro-order CALC_EUROPLEXUS,
- the taking into account of the relations kinematics resulting from DEFI_CABLE_BP in the presence of the law GLRC_DAMAGE.

1 Description

1.1 Geometry

The concrete plate is made of a square length of edges $L=0,9\,m$ and thickness $e=0,6\,m$. The four tops of the plate are named A_1, A_2, A_3 and A_4.

A cable, located on the segment $[A_3\,A_4]$, the plate crosses horizontally, without eccentricity in the thickness. The surface of the cross-section of the cable is worth $S_a=1.10^{-4}\,m^2$.

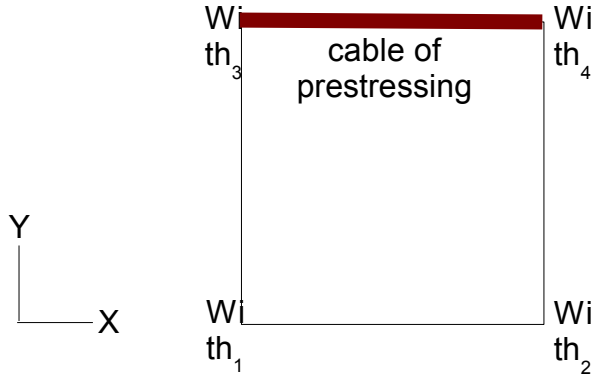

Figure 1.1-1: Geometry

1.2 Properties of materials

The plate is out of reinforced concrete and the rope steel wire. The properties of the reinforced concrete results from the homogenisation of the properties of the concrete and the properties of the reinforcements thanks to the order DEFI_GLRC.

Material	Concrete	Reinforcements	Steel of the cable
Young modulus	$E_b=3,57.10^{10}\,Pa$	$E_a=2.1.10^{11}\,Pa$	$E_a=2.1.10^{11}\,Pa$
Poisson's ratio	$\nu_b=0.2$	$\nu_a=0$	$\nu_a=0$
Density	$m_b=2500\,kg/m^3$	$m_a=7500\,kg/m^3$	$m_a=7500\,kg/m^3$

Table 1.2-1: Properties of materials.

1.3 Boundary conditions and loadings

Segments $[A_1\,A_2]$ and $[A_1\,A_3]$ are respectively blocked according to the direction Y and direction X. The segment $[A_2\,A_4]$ as for him is blocked according to the direction Z like in rotation around the three axes.

The loading is applied in two stages. The first quasistatic calculation makes it possible to prestress the cable with a tension $T=2,0.10^5\,N$. Then one applies a uniform pressure directed positively according to the direction $-Z$ on the complete surface of the plate. Its maximum amplitude is $P_{max}=0,15\,MPa$, and it is associated with a slope going from 0 with 1 between the moments $t_{initial}=0\text{s}$ and $t_{final}=0.004\text{s}$.

2 Reference solution

It is about a test of nonregression concerning the calculation carried out with the order DYNA_NON_LINE . This last is used then as reference to the calculation carried out by Europlexus thanks to the macro-order CALC_EUROPLEXUS .

3 Modeling A

3.1 Characteristics of modeling

The reinforced concrete plate uses modeling Q4GG while the cable is in modeling BAR.

3.2 Characteristics of the grid

The reinforced concrete plate is made up of 72 elements T3GG, while the cable is modelled by 6 elements BAR.

3.3 Sizes tested and results

One tests displacement according to the direction Z top A_1. The first calculation with DYNA_NON_LINE is instrumented by a test of nonregression, which is used as reference to the calculation carried out with Europlexus via the macro one - order CALC_EUROPLEXUS .

Identification	Type of reference	Value of reference	Tolerance
DYNA_NON_LINE - Not A_1 - DZ	'NON_REGRESSION'	-4.3214499919696. 10^{-4}	1.10^{-6} %
CALC_EUROPLEXUS - Not A_1 - DZ	'AUTRE_ASTER'	-4.3214499919696. 10^{-4}	0.5 %

Table 3.3-1: Sizes tested

4 Synthesis

Calculation done with Europlexus via CALC_EUROPLEXUS took well into account the various parameters of the law GLRC_DAMAGE.

The calculation of prestressed cable made it possible to validate this functionality when the concrete is modelled by the law of behavior GLRC_DAMAGE .