1.- Identify in the code (file, lines) the following items:

a) The definition of the example (loading, geometry):

In the *preprocessing.m* file there is a switch where all the examples are defined, they can be chosen in line 11 of *main_incremental_iterative.m.*

The function preprocessing has available in total 6 kind of examples. In addition, there are also two kinds of materials that can be implemented.

The geometry of the example is implemented in the file *preprocessing.m* in the lines 8 to 59 and the loading is applied by means of the parameter *codeLoad*. If *codeLoad*=0, then it is an applied load, if c*odeLoad*=1, then it is an applied displacement.

b) The choice of solution method (Newton's method with or without line-search)

The choice of the solution method is made in the file *main_incremental_iterative.m* in the line 20 and 21.

This choice is made in the structure *options* in the fields *method* and *linesearch.*

c) The implementation of the solution method

The solution method is implemented in the file *main_incremental_iterative.m* in the line *26.* Then, this parameter is used in the file *LineSeach.m.*

The Newton-Raphson method is implemented in *Equilibrate.m.*

d) The implementation of the incremental-iterative strategy, with smart initial guesses for imposed displacements.

This strategy is implemented in the file *main_incremental_iterative.m* with the loop in line 40 among the lines 44 and 48.

e) The introduction of random perturbations in the initial guesses of the solution method.

The introduction of random perturbations is made in the file *main_incremental_iterative.m,* line 50. This option can be used or not by commenting it or not.

2.- Run the following tests

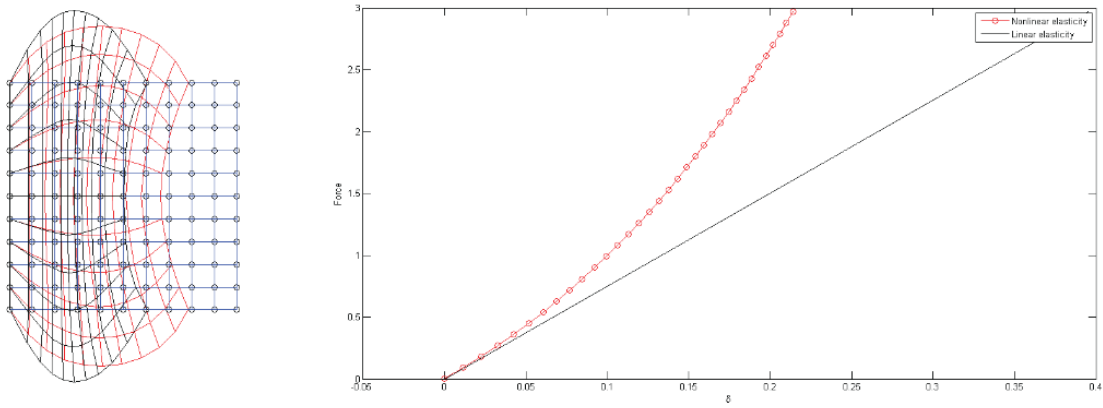a) Example 0 without line-search and for mod1.force = -3e0 and mod1.force = 3e0
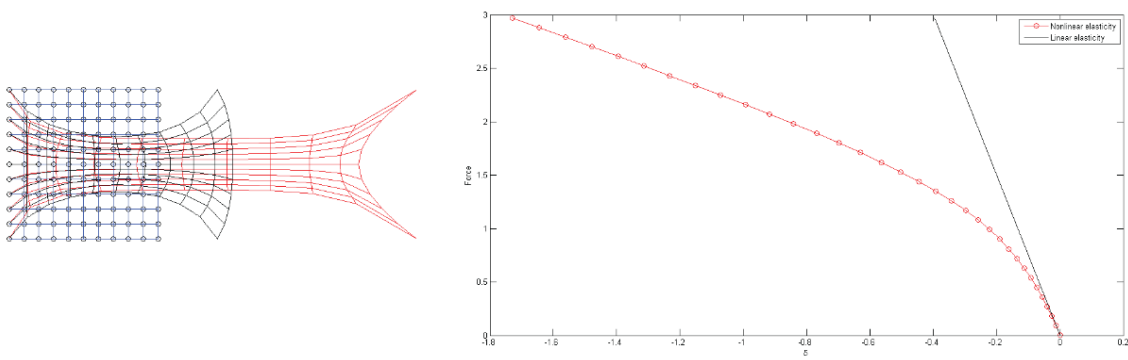

Fig.1: Example 0 without line-search and for mod1.force = -3e0

Fig.2: Example 0 without line-search and for mod1.force = 3e0

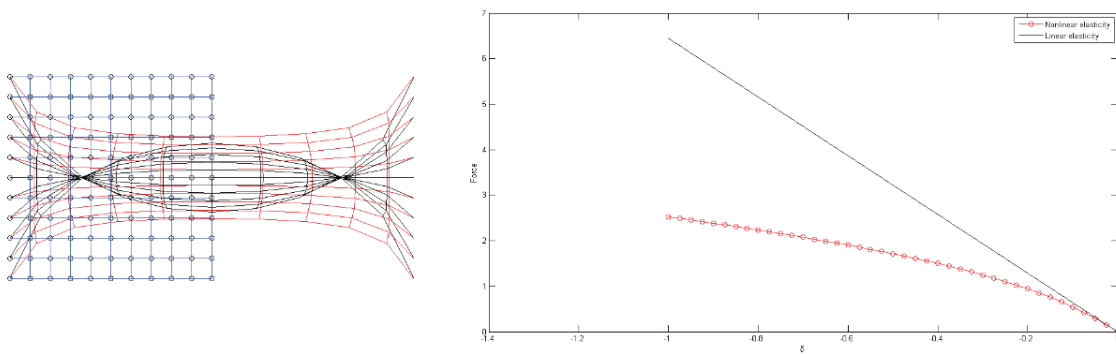b) Example 1 without line-search and for lambda=[1:.025:2] and lambda=[1:-.01:0.5]

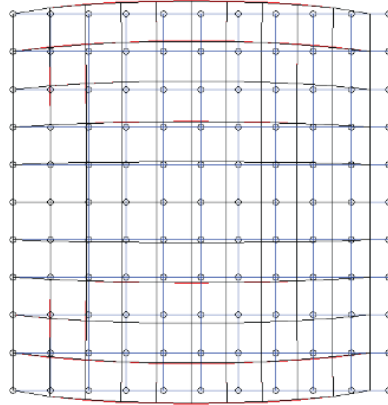Fig.3: Example 1 without line-search and for lambda=[1:.025:2]

Fig.4: Example 1 without line-search and for lambda=[1:-.1:0.5]

In this particular case, the equilibrium is not achieved properly, so the solution of the non linear problem is not stable. As a result, the result given by the program cannot be taken into account.

c) Examples 2 and 3 with and without line-search, with and without random perturbations.
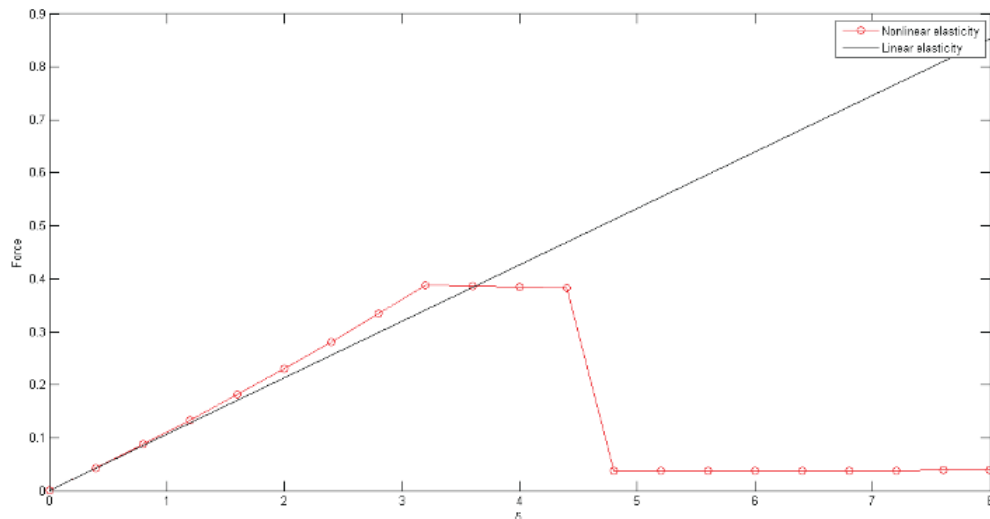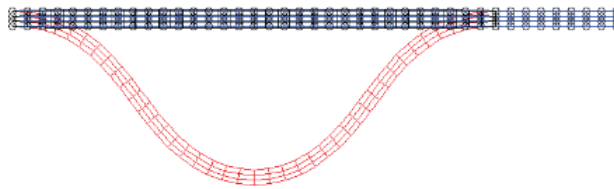

Fig.5: Example 2 with line-search and with random perturbation

It is clearly evident that with a line search it is achieved a stable solution. With this last method, buckling of the beam is taken into account as it happens in the reality.
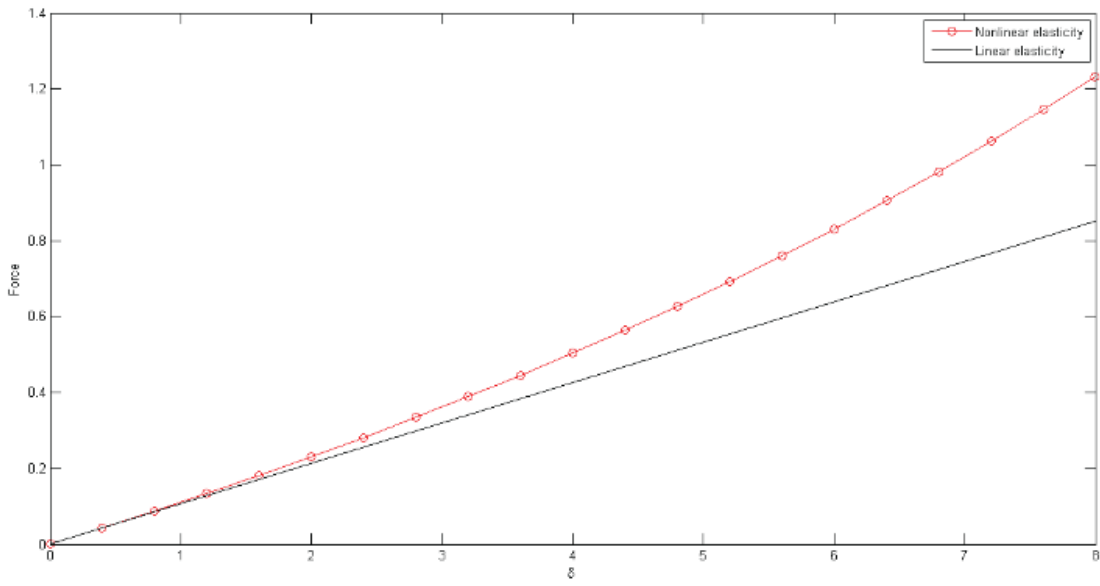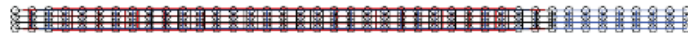
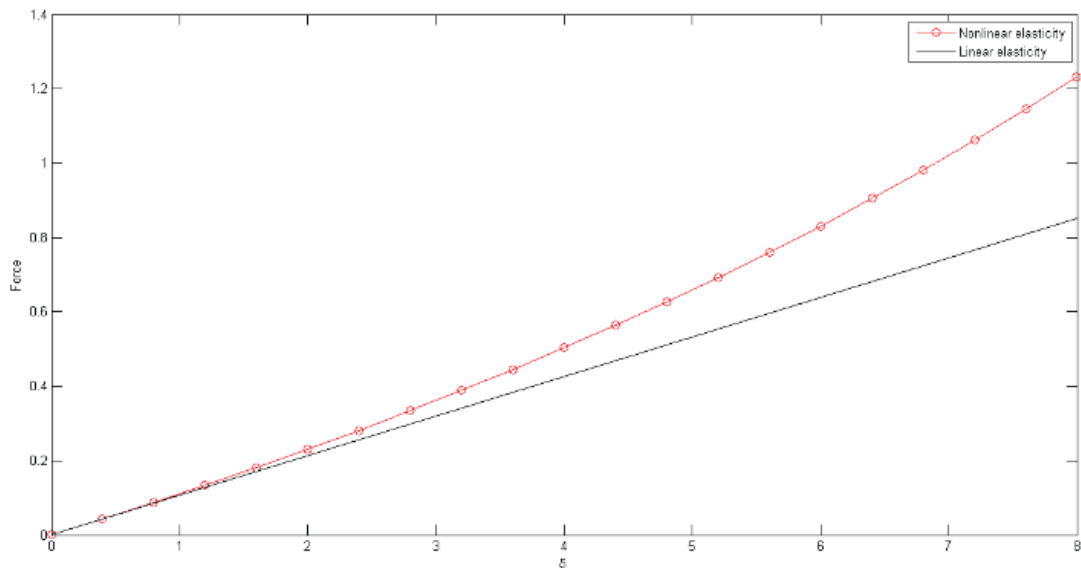Fig.6: Example 2 without line-search and without random perturbation
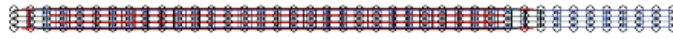

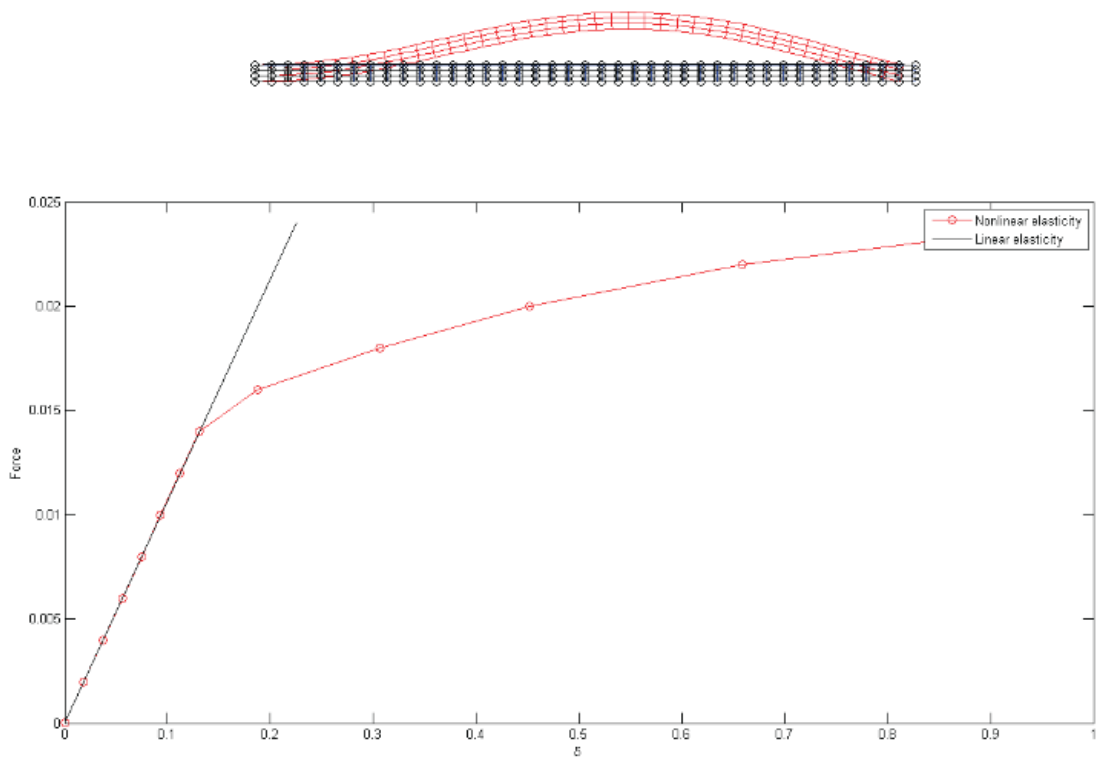Fig.7: Example 2 with line-search and without random perturbation

Fig.8: Example 3 with line-search and with random perturbation
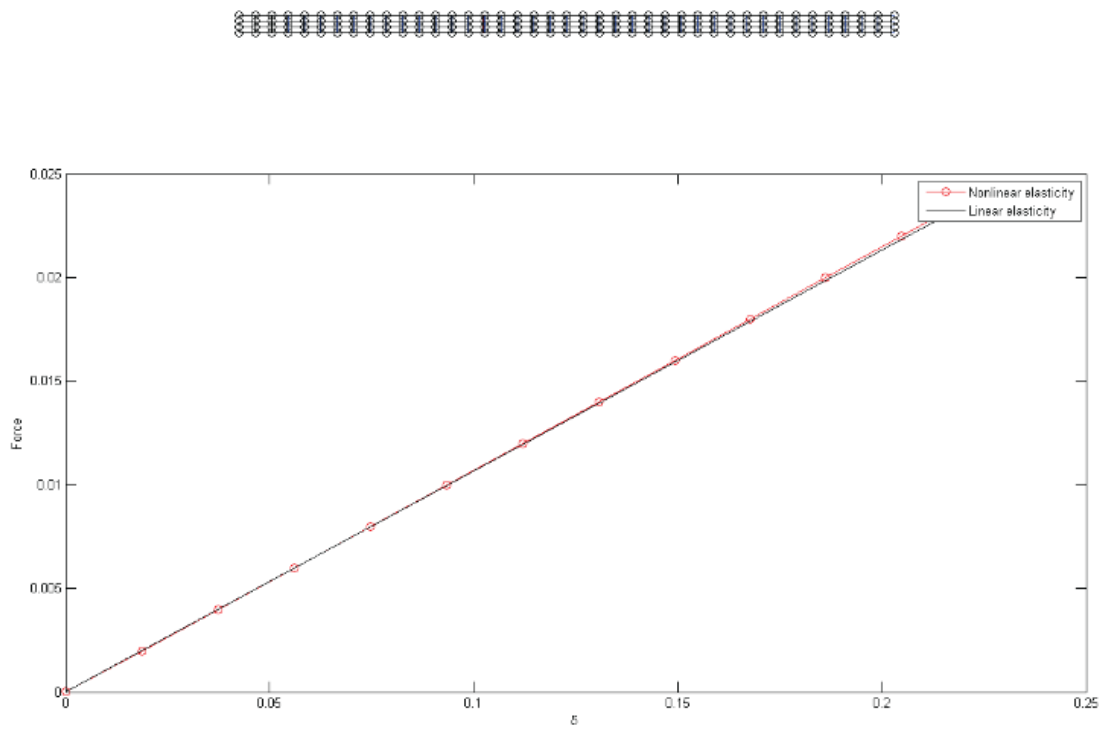

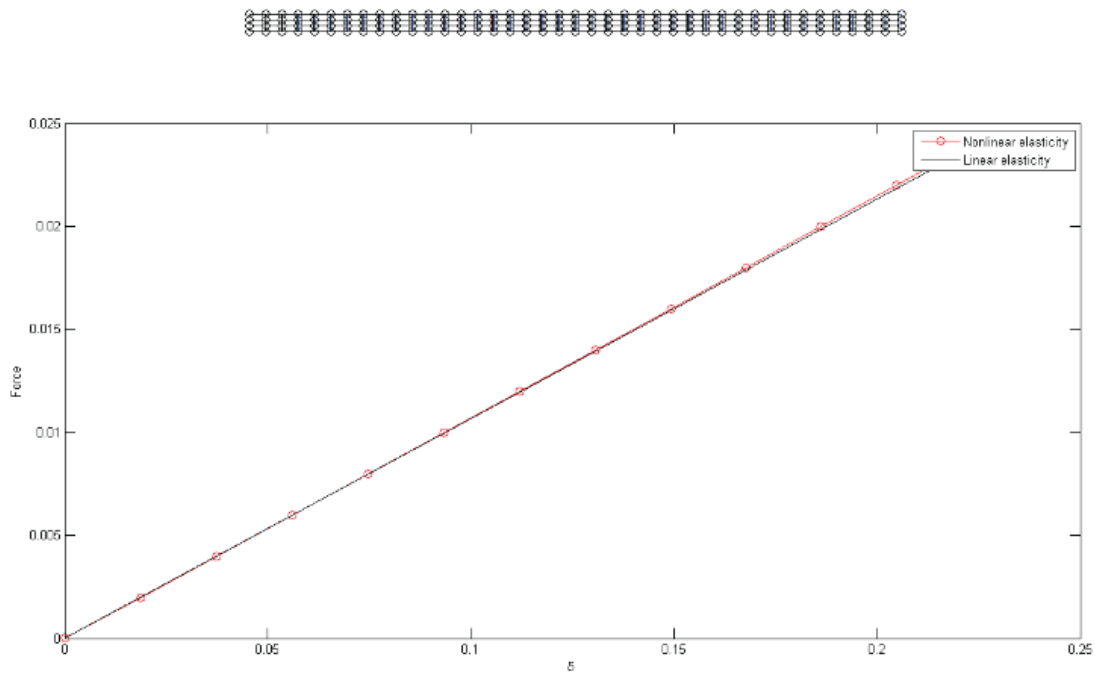Fig.9: Example 3 without line-search and without random perturbation

Fig.10: Example 3 with line-search and without random perturbation

As it can be seen in this last example, also the searching without random perturbations gives an unrealistic result, as the beam is just in compression and not buckling is taken into account.

d) Examples 4 and 5 with and without line-search, without random perturbations.

In Examples 4 and 5 without line- search and without random perturbations the equilibrium is not achieved properly, so the solution of the non linear problem is not stable. So the result given by the program cannot be taken into account. The other results can be seen as follow.
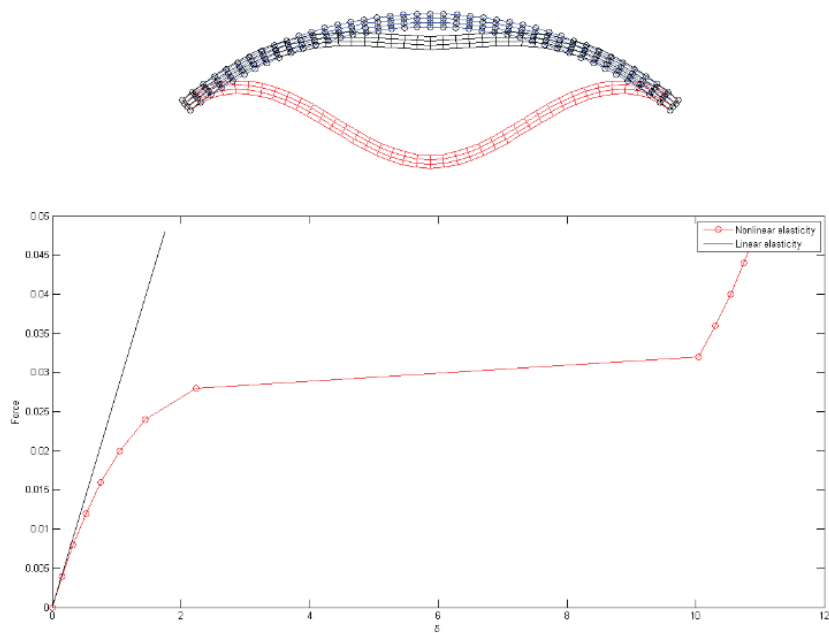

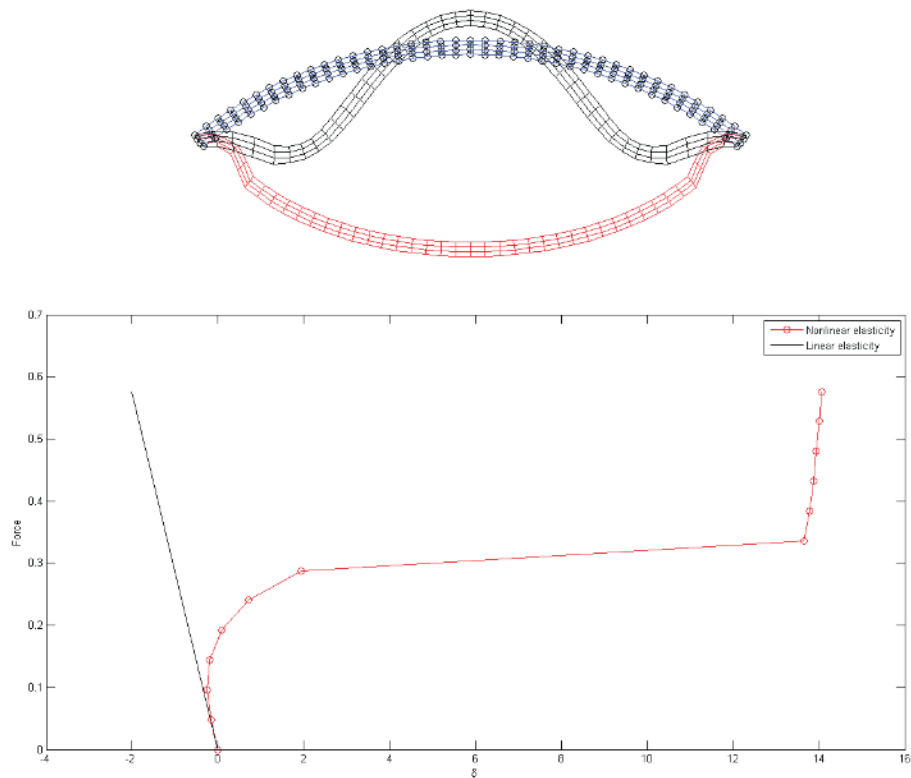Fig.11: Example 4 with line-search and without random perturbation

Fig.12: Example 5 with line-search and without random perturbation

3.- Discuss

a)Proportionality of the response with respect to the loads

Example 0 shows the differences in response in terms of proportionality between both models. Linear model is proportional and displacement increases linearly with the load increment. However this fact is not reproduced for the nonlinear behavior.

b) Symmetry of the response with respect to the sign of the loads

Example 0 gives a clear example of the symmetry of the response with respect to the sign of the loads and also the proportionality of the loads. In the linear model, a change of the sense of the loads only produces a change in the sense of the displacement. However, in the non linear analysis, this behavior does not exist. There is more displacement in traction than in compression.

c) Unicity of solutions

The solution is always the same for the linear model. However the nonlinear model depends on the method used to solve the problem, also it is influenced by the use of line-search and random perturbations.

d) Stability of the solutions

For the linear model the solution is always stable, but for the nonlinear model the stability fails when the method does not incorporate line-search.