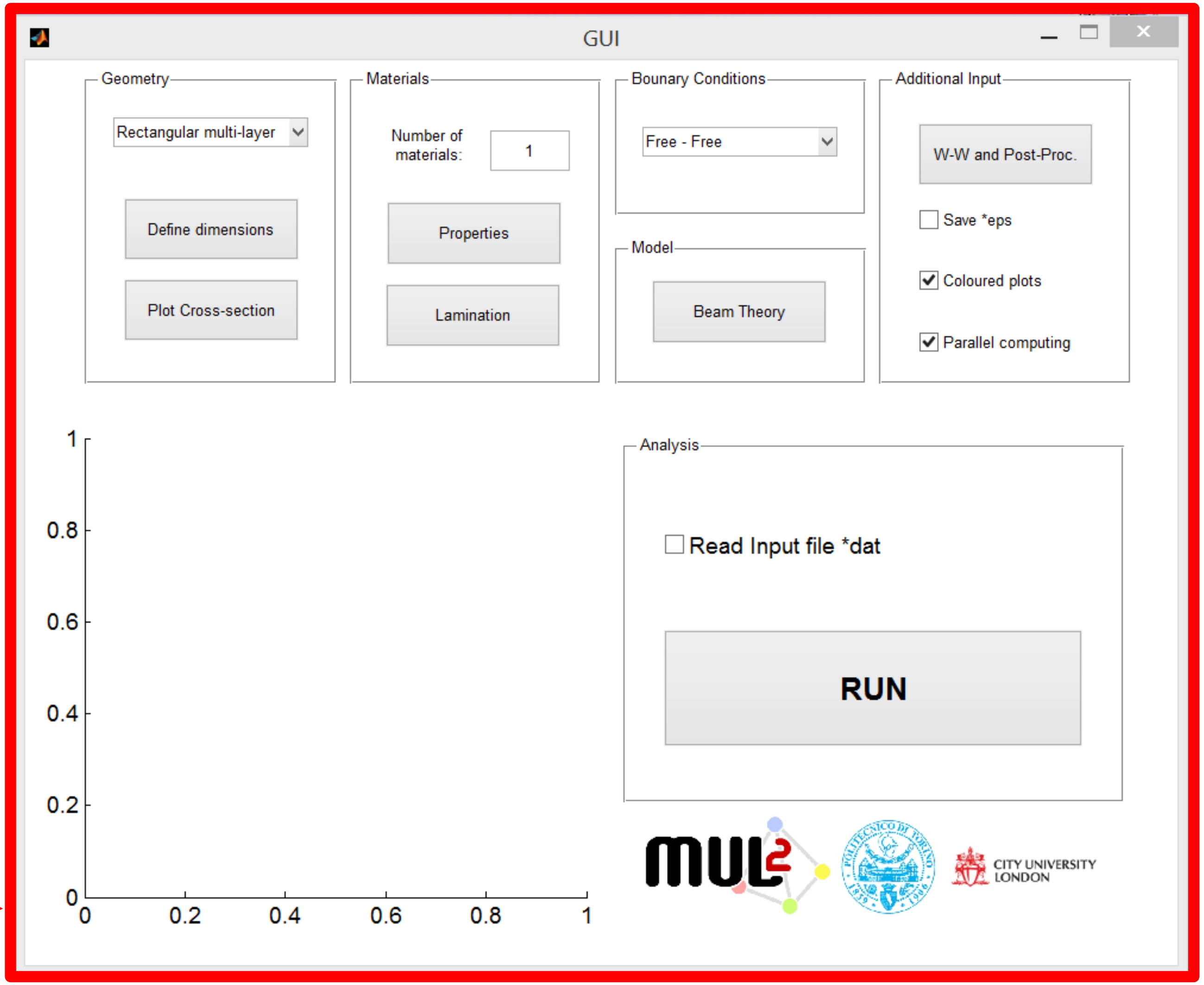
Dynamic Stiffness Analysis of Advanced Beams (DySAAB)

A. Pagani, 2014

The DySAAB Graphical User Interface (GUI)

DySAAB GUI

Console Application



DySAAB

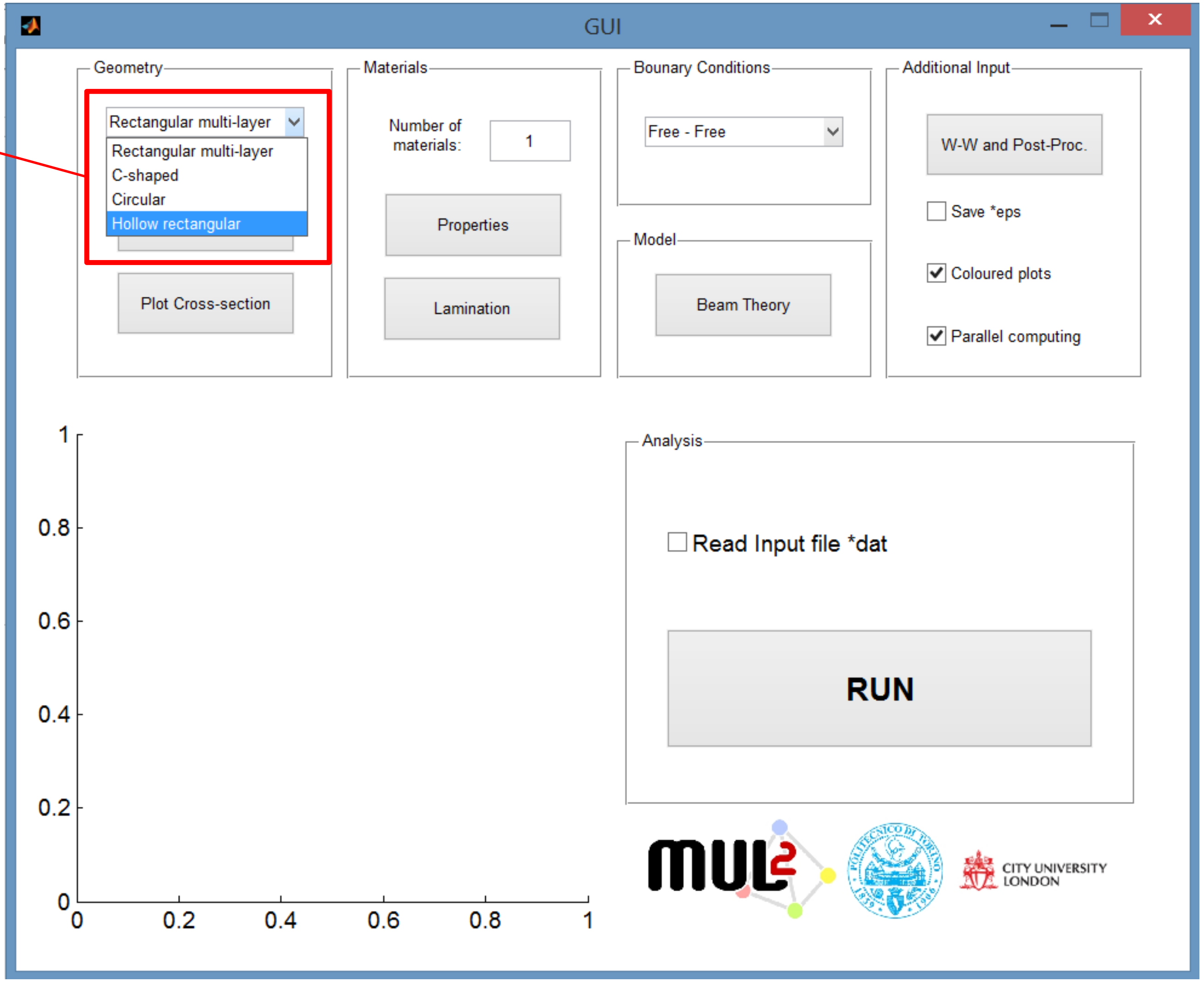
DySAAB GUI

STEP 1 - Geometry

1.1 Define the cross-section

At the moment, only rectangular, C-shaped, circular and box cross-sections can be analysed. Multi-layered orthotropic cross-section can only be used in the case of rectangular section beams.

The possibility to deal with arbitrary geometries will be implemented in the second part of this year.



DySAAB GUI

STEP 1 - Geometry

1.2 Push *''Define dimensions''* button

A new window appears. The format of the window depends on the cross-section type. In this example a box beam is selected.

1.3 Enter the geometry properties of the beam

Press OK to confirm.

DySAAB GUI

STEP 1 - Geometry

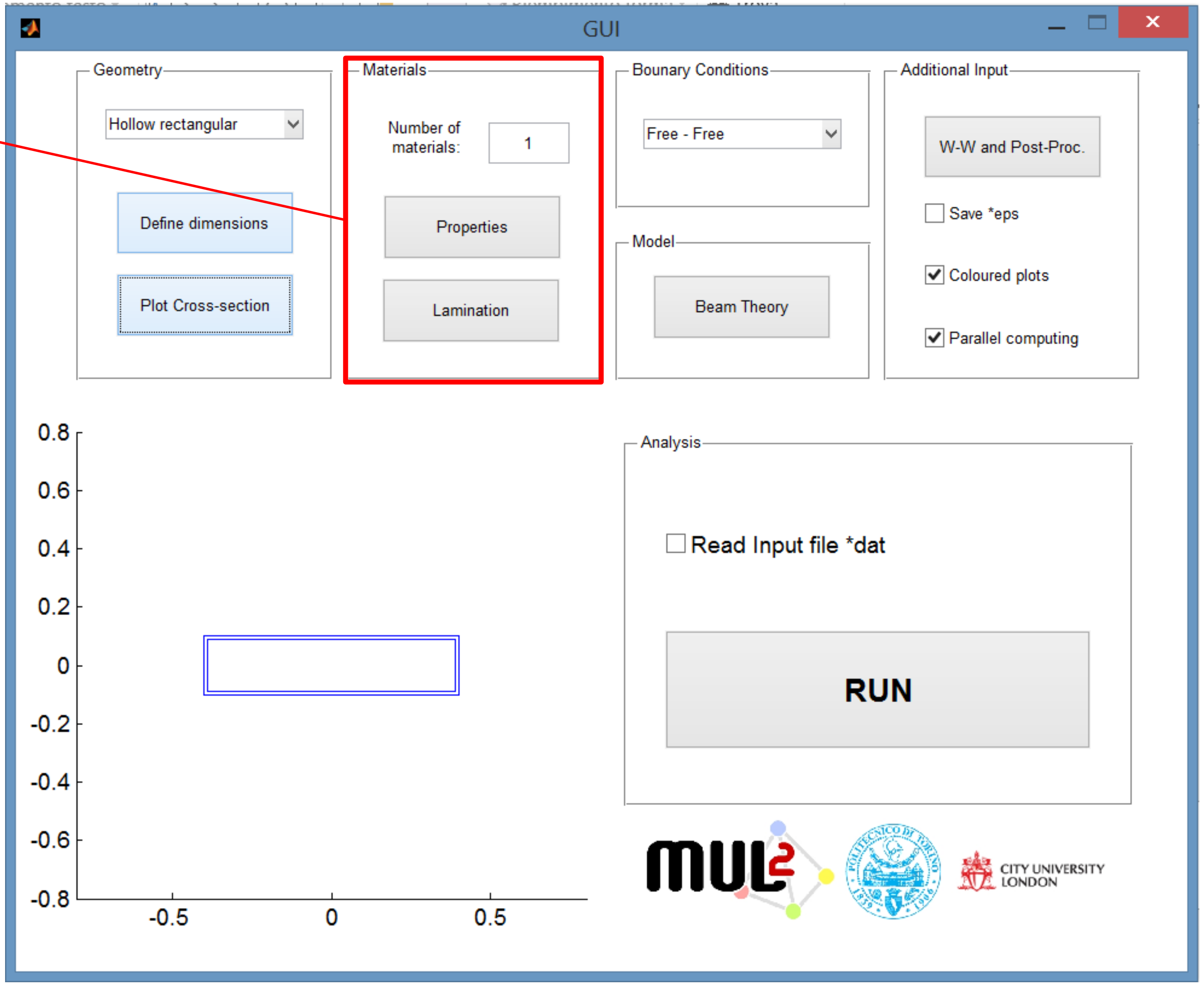
1.4 Push *''Plot Cross-section''* button

This is necessary to acquire the geometry of the beam. The cross-section is drawn in the window below in order to let the user check the input.

DySAAB GUI

STEP 2 - Material

2.1 Enter the number of different materials

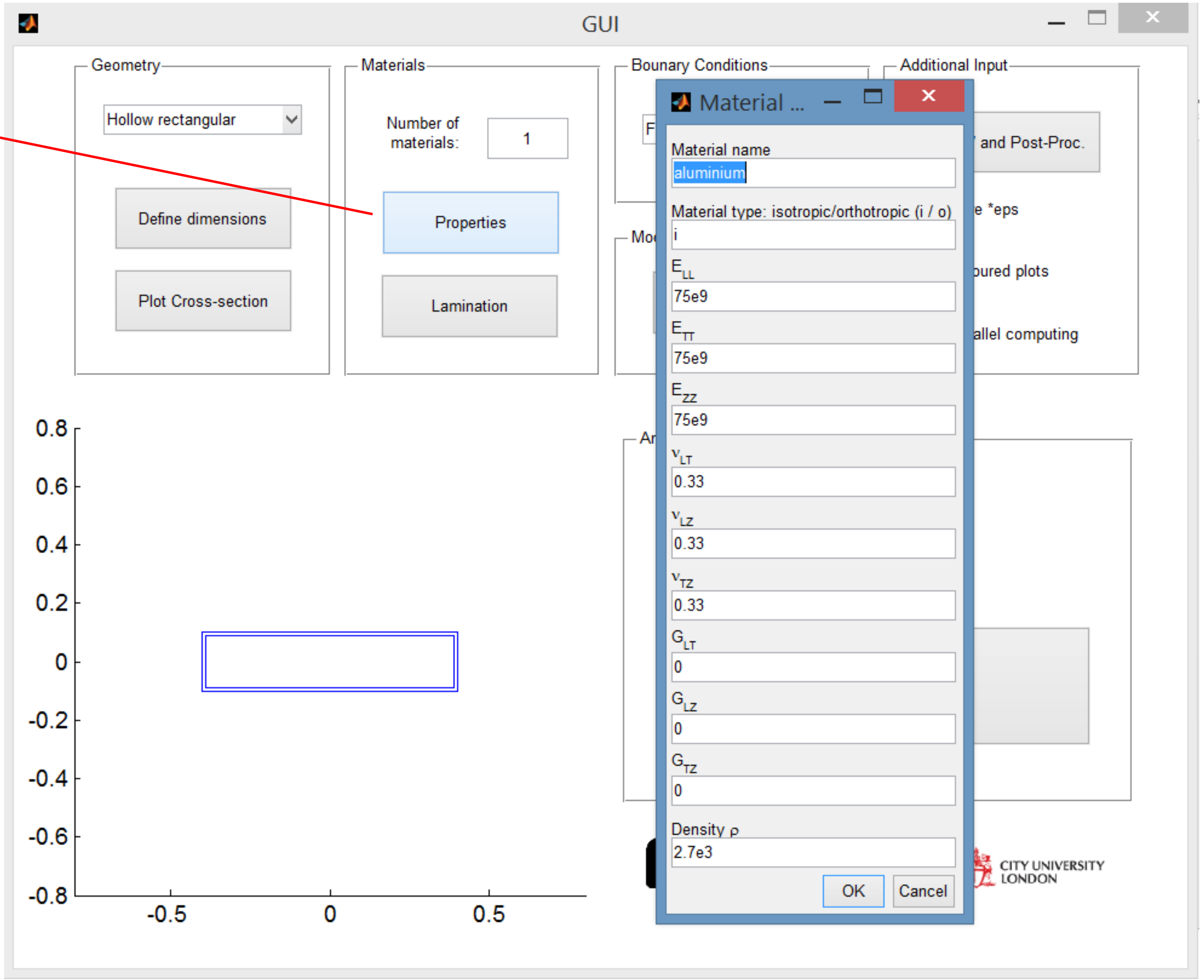


DySAAB GUI

STEP 2 - Material

2.2 Push the ‘’Properties’’ button

Enter the material name and properties in the new windows. Press OK to confirm.

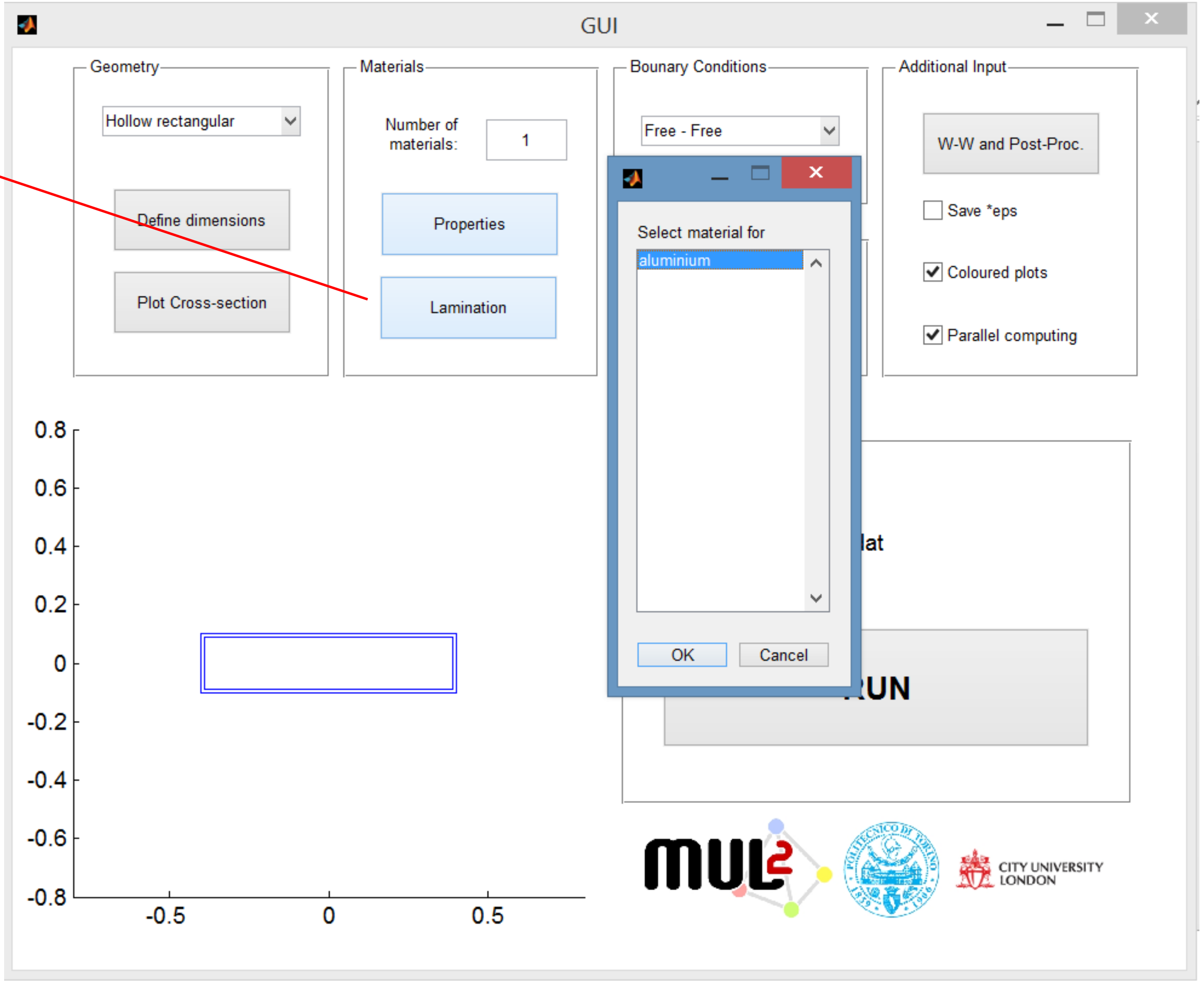


DySAAB GUI

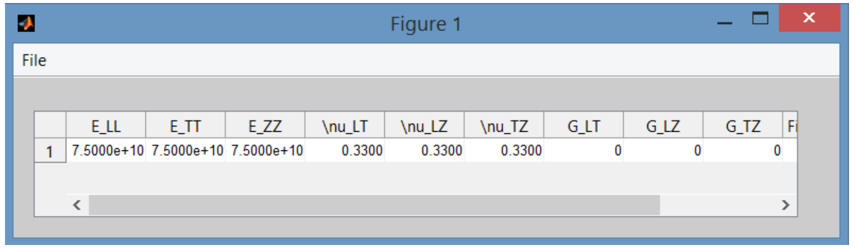
STEP 2 - Material

2.3 Push the ‘Lamination’’ button

This window is necessary to define the lamination, i.e. stacking sequence and material composition on the cross-section. In this case an isotropic aluminium material is considered. So, select it and press OK.



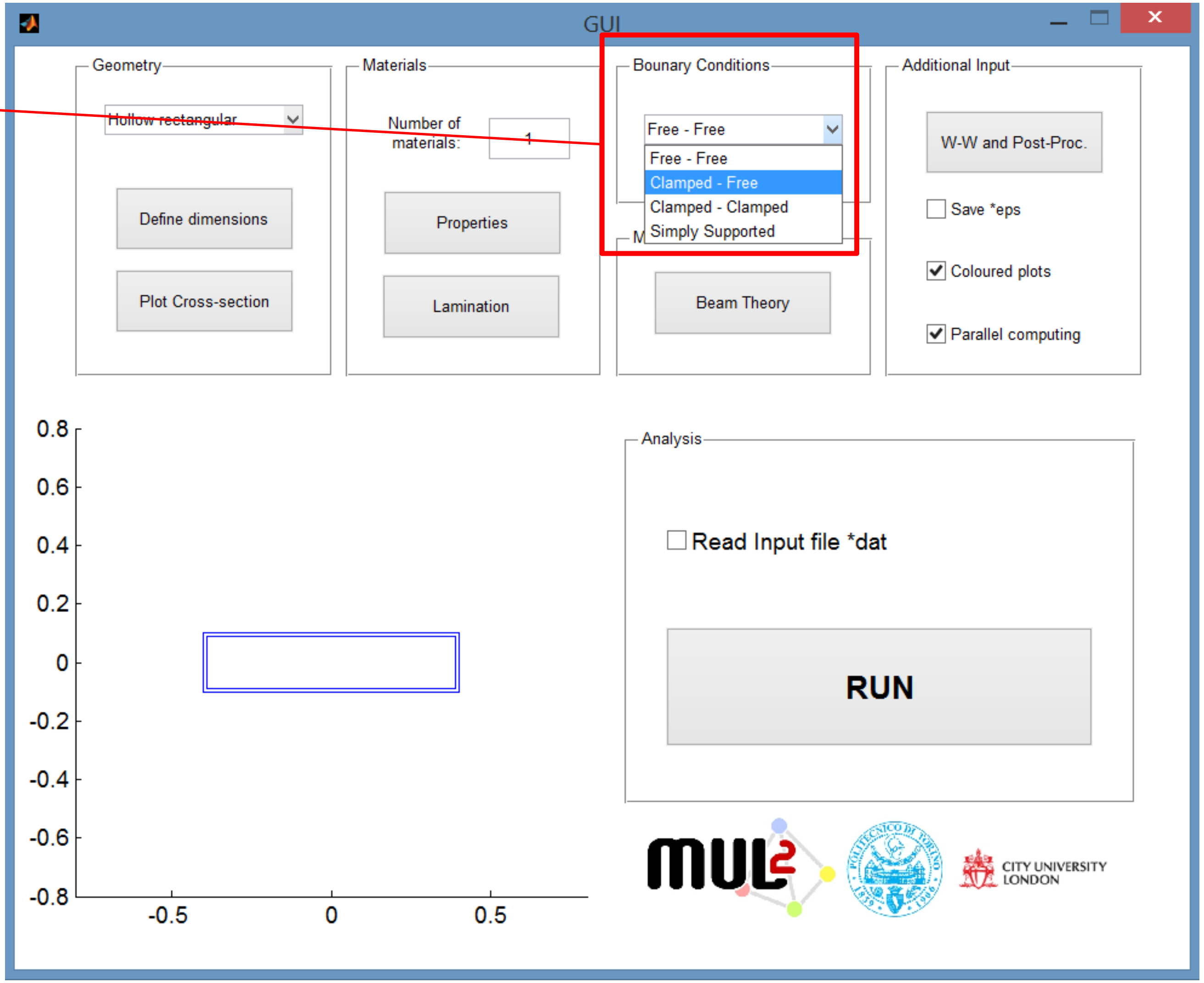
A new window appears. This window is useful to check the input. You can close the window after checking.



DySAAB GUI

STEP 3 – Boundary Conditions

Select the end-to-end boundary conditions you want to use.



DySAAB GUI

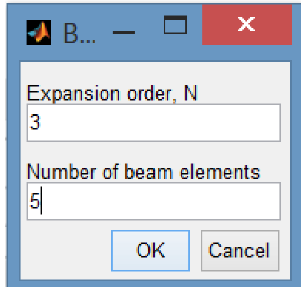
STEP 4 – Model

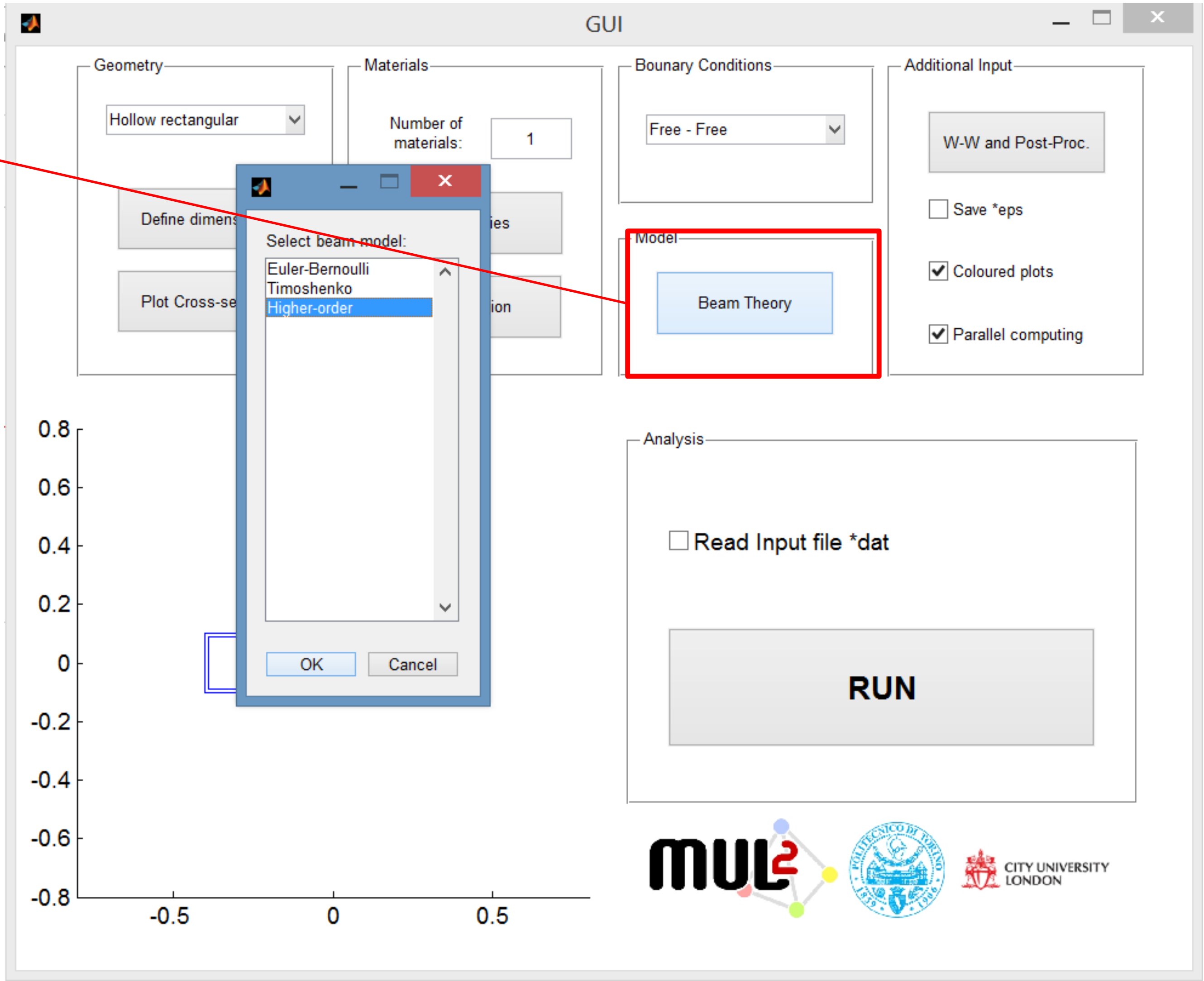
4.1 Push the ‘’Beam Theory’’ button

4.2 In the new window, select the beam theory you want to use

User can choose among Euler-Bernoulli and Timoshenko classical beam theories and higher-order TE CUF models.

If ‘’Higher-order’’ is choose, the following window opens. Select the theory order N and the number of DS elements.



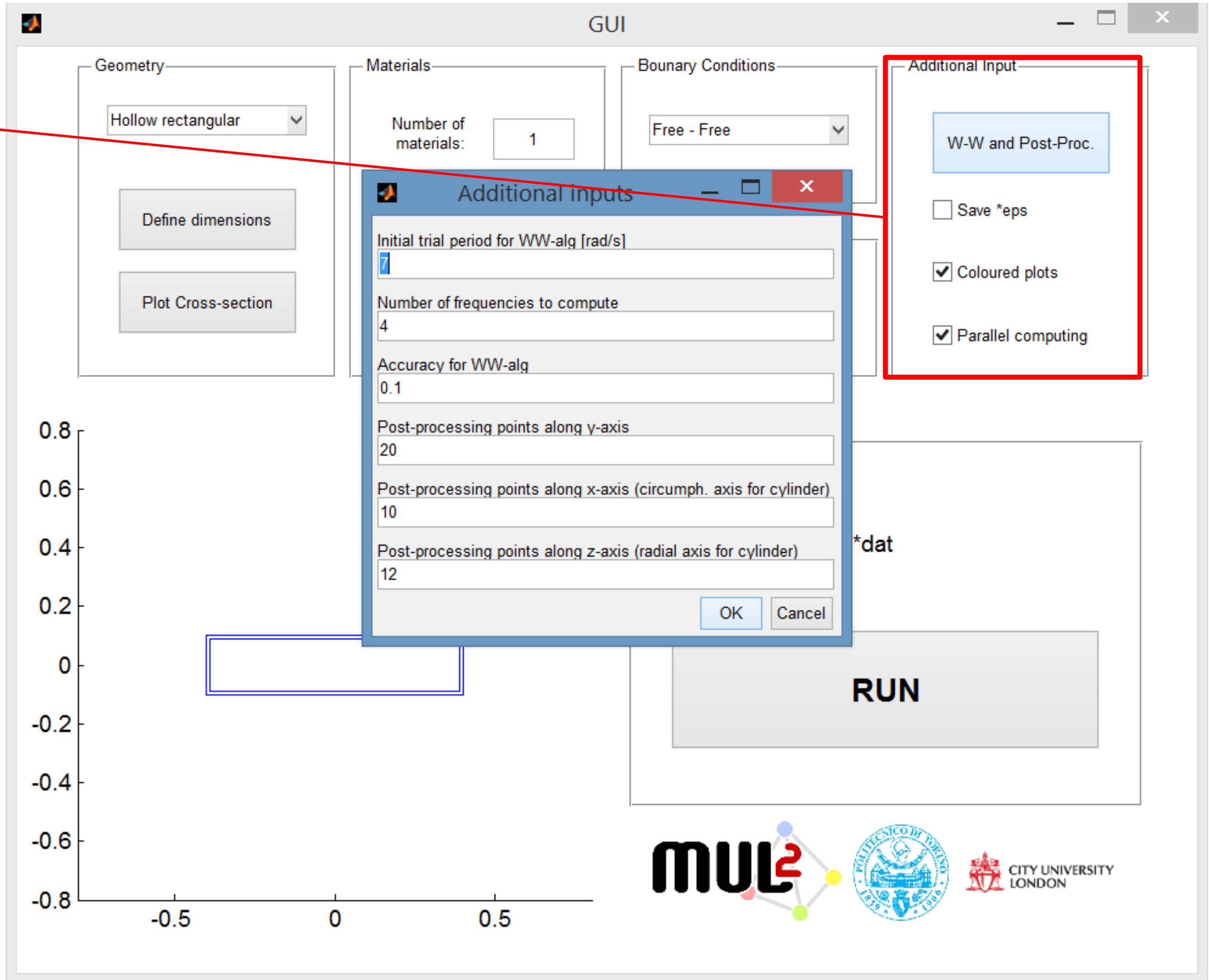


DySAAB GUI

STEP 5 – Additional Input

5.1 Push the ‘’W-W and Post-Proc.’’ button

In the new window that opens, some input regarding the W-W algorithm and post-processing have to be specified. Press OK to confirm.



DySAAB GUI

STEP 5 – Additional Input

5.2 Tick or un-tick ‘’save *.eps’’

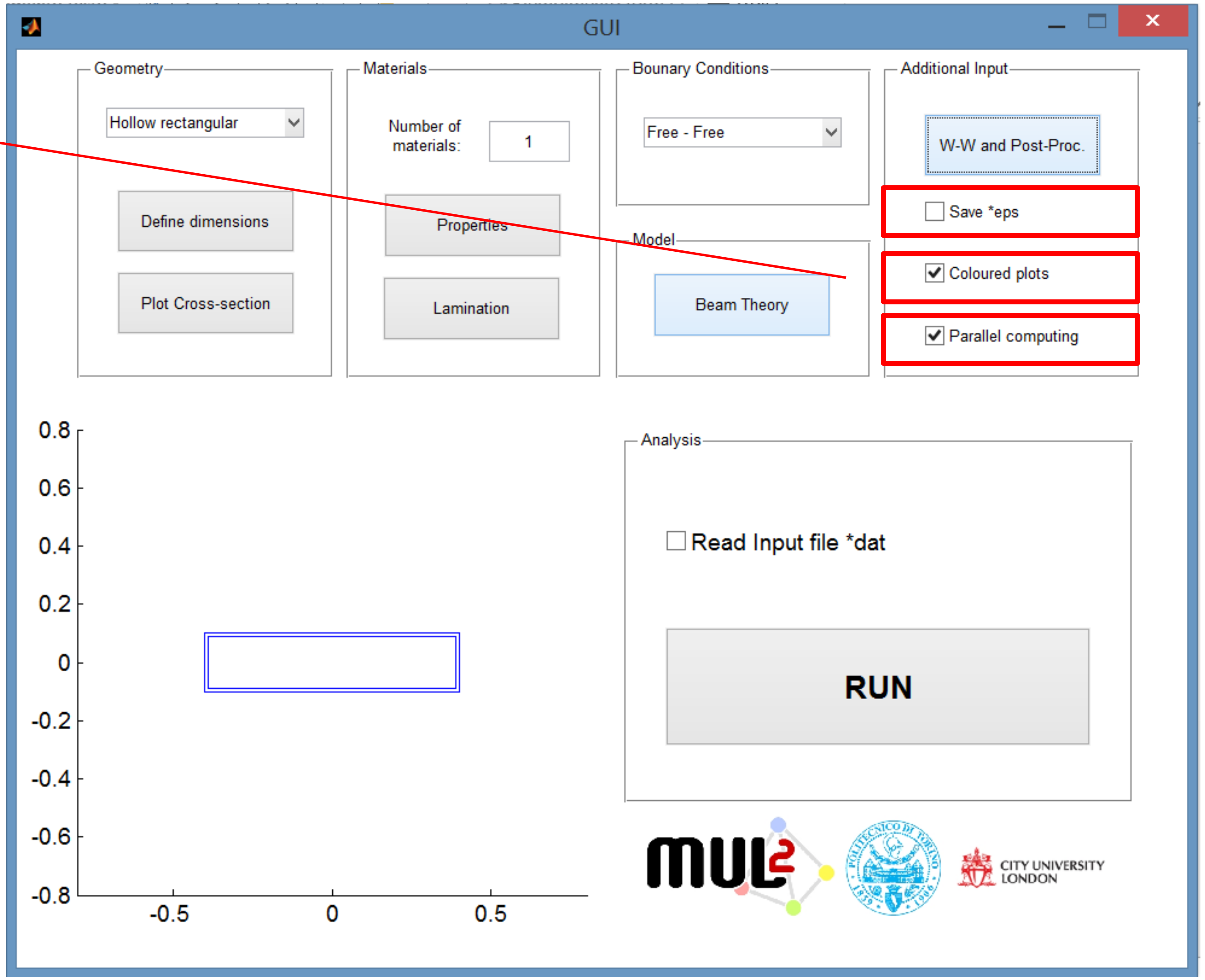
If activated, the modes are automatically saved as images in .eps format into the result folder. Anyway, modes are saved in a single .gmsh interactive file.

5.3 Tick or un-tick ‘’Coloured plots’’

If activated, the modes are shown and saved in colour. Otherwise, b/w scale is used.

5.4 Tick or un-tick ‘’Parallel computing’’

Activate to run in parallel computation mode.

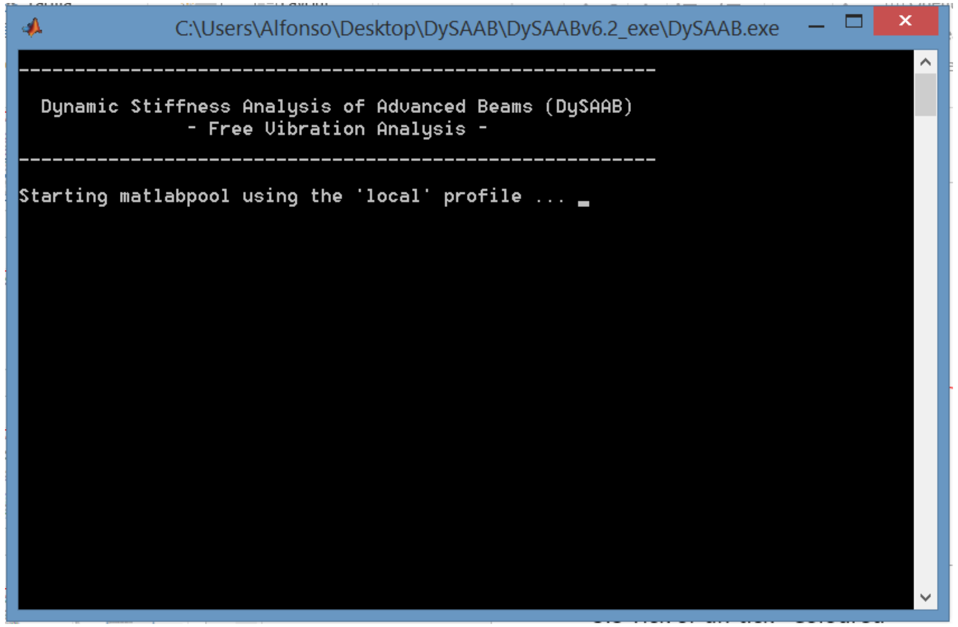


DySAAB GUI

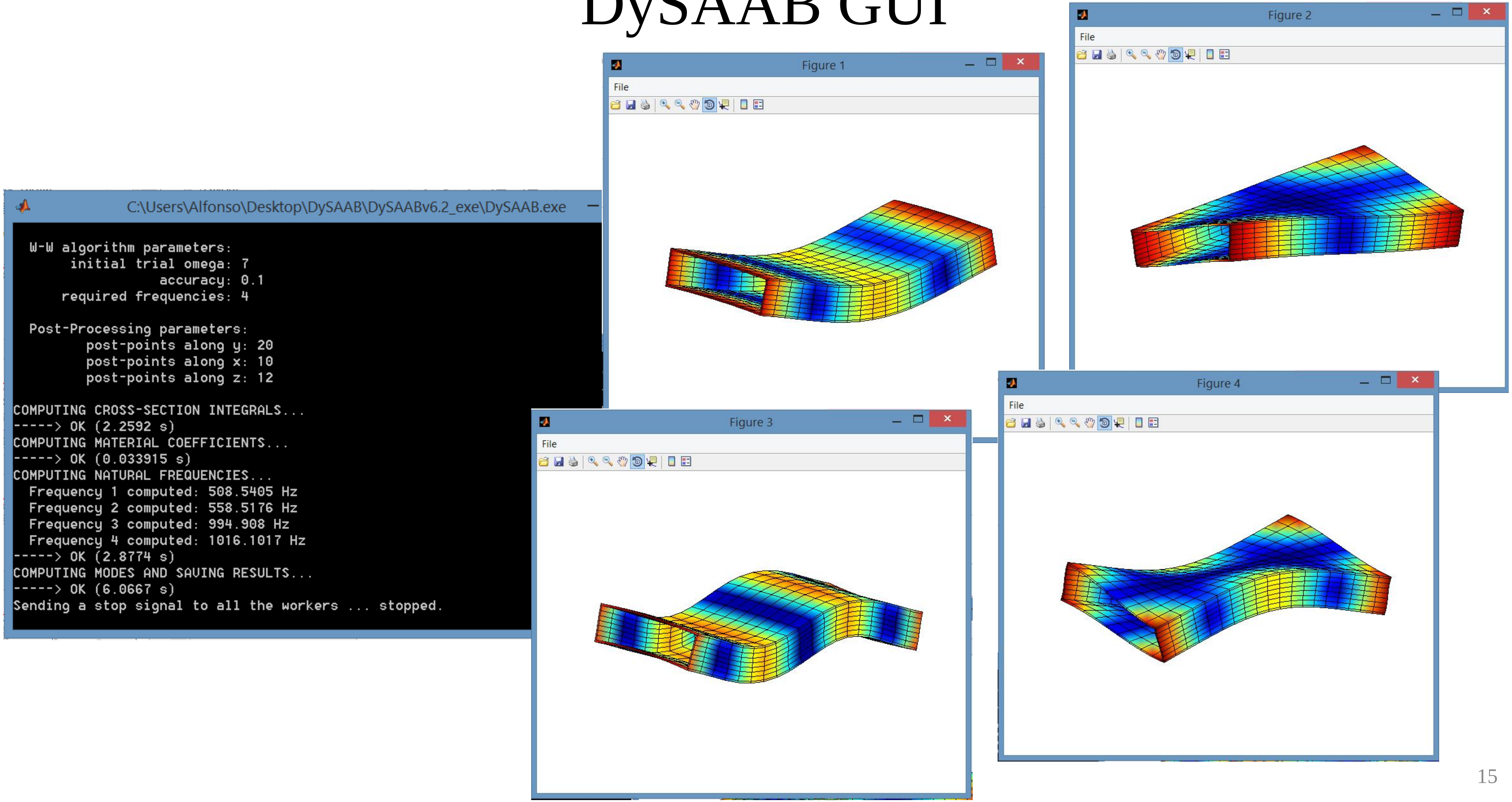
STEP 6 – Run Analysis

Press ‘’RUN’’ button to run analysis

Analysis progress is shown in the Console Application

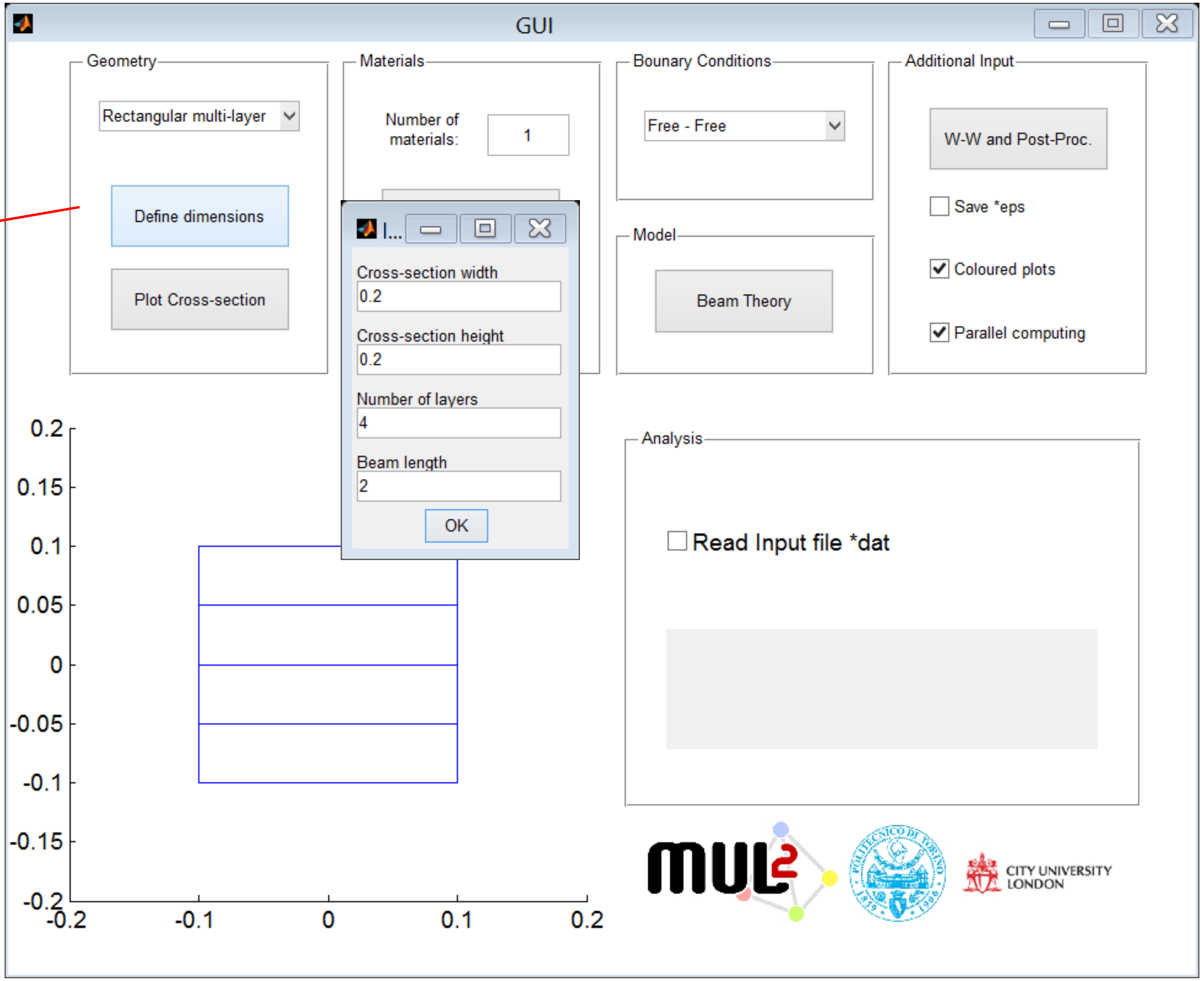


DySAAB GUI


C:\Users\Alfonso\Desktop\DySAAB\DySAABv6.2_exe\DySAAB.exe
W-W algorithm parameters:
initial trial omega: 7
accuracy: 0.1
required frequencies: 4
Post-Processing parameters:
post-points along y: 20
post-points along x: 10
post-points along z: 12
COMPUTING CROSS-SECTION INTEGRALS...
-----> OK (2.2592 s)
COMPUTING MATERIAL COEFFICIENTS...
-----> OK (0.033915 s)
COMPUTING NATURAL FREQUENCIES...
Frequency 1 computed: 508.5405 Hz
Frequency 2 computed: 558.5176 Hz
Frequency 3 computed: 994.908 Hz
Frequency 4 computed: 1016.1017 Hz
-----> OK (2.8774 s)
COMPUTING MODES AND SAVING RESULTS...
-----> OK (6.0667 s)
Sending a stop signal to all the workers ... stopped.
Figure 1
File
Figure 2
File
Figure 3
File
Figure 4
File

DySAAB GUI – Laminated beam

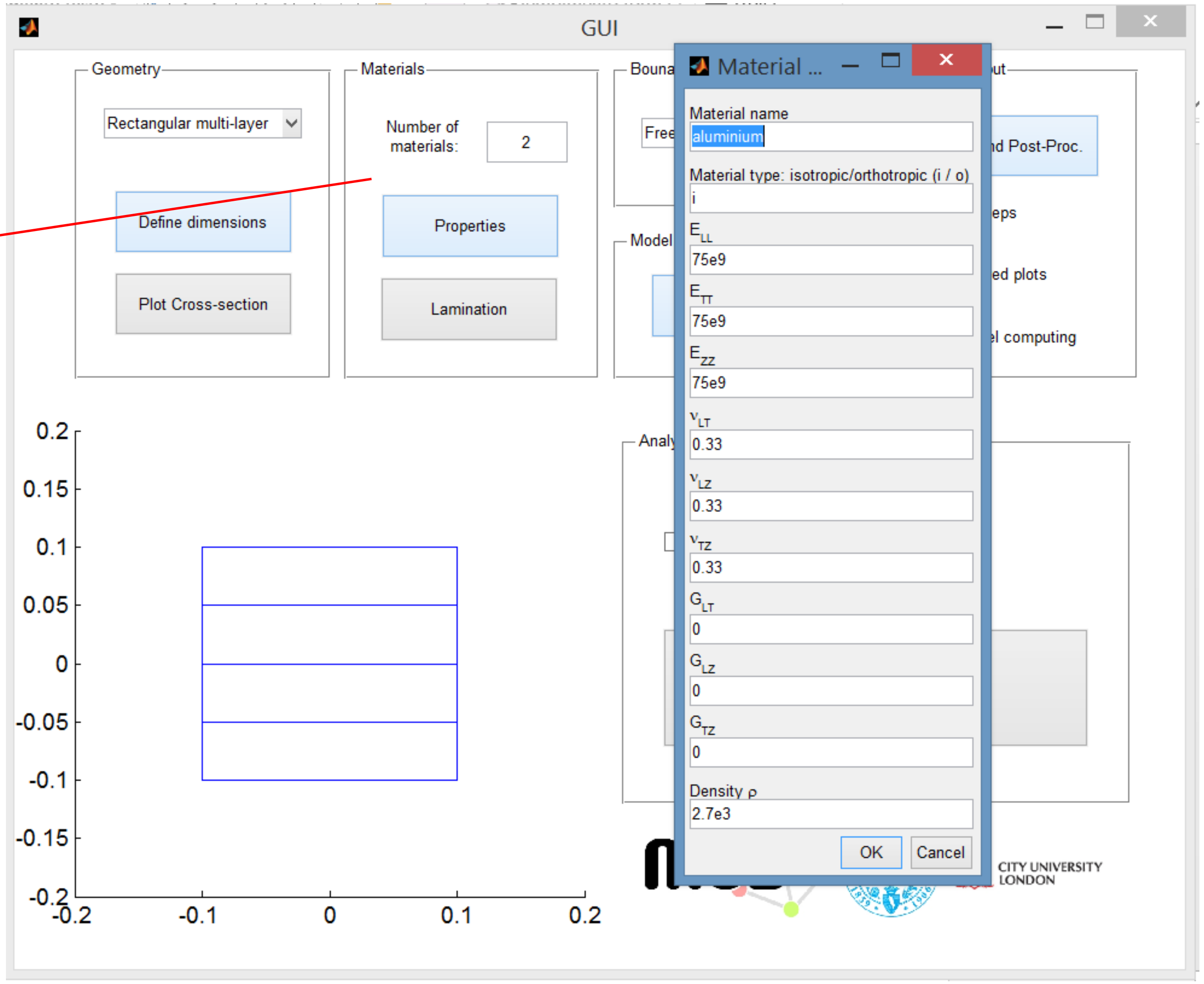
STEP 1 - Geometry



DySAAB GUI – Laminated beam

STEP 2 – Material

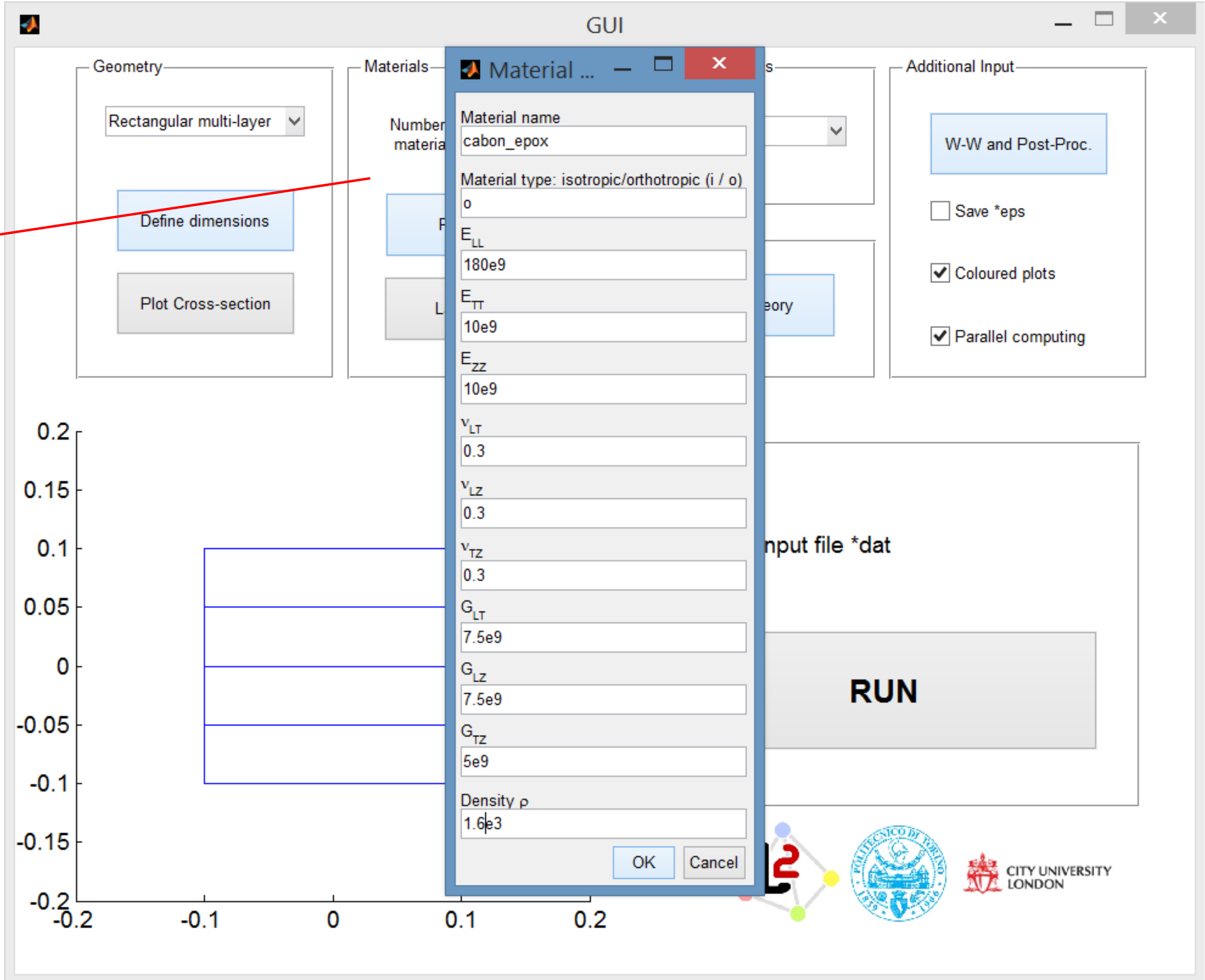
Define material 1, aluminium



DySAAB GUI – Laminated beam

STEP 2 – Material

Define material 2, carbon_epox

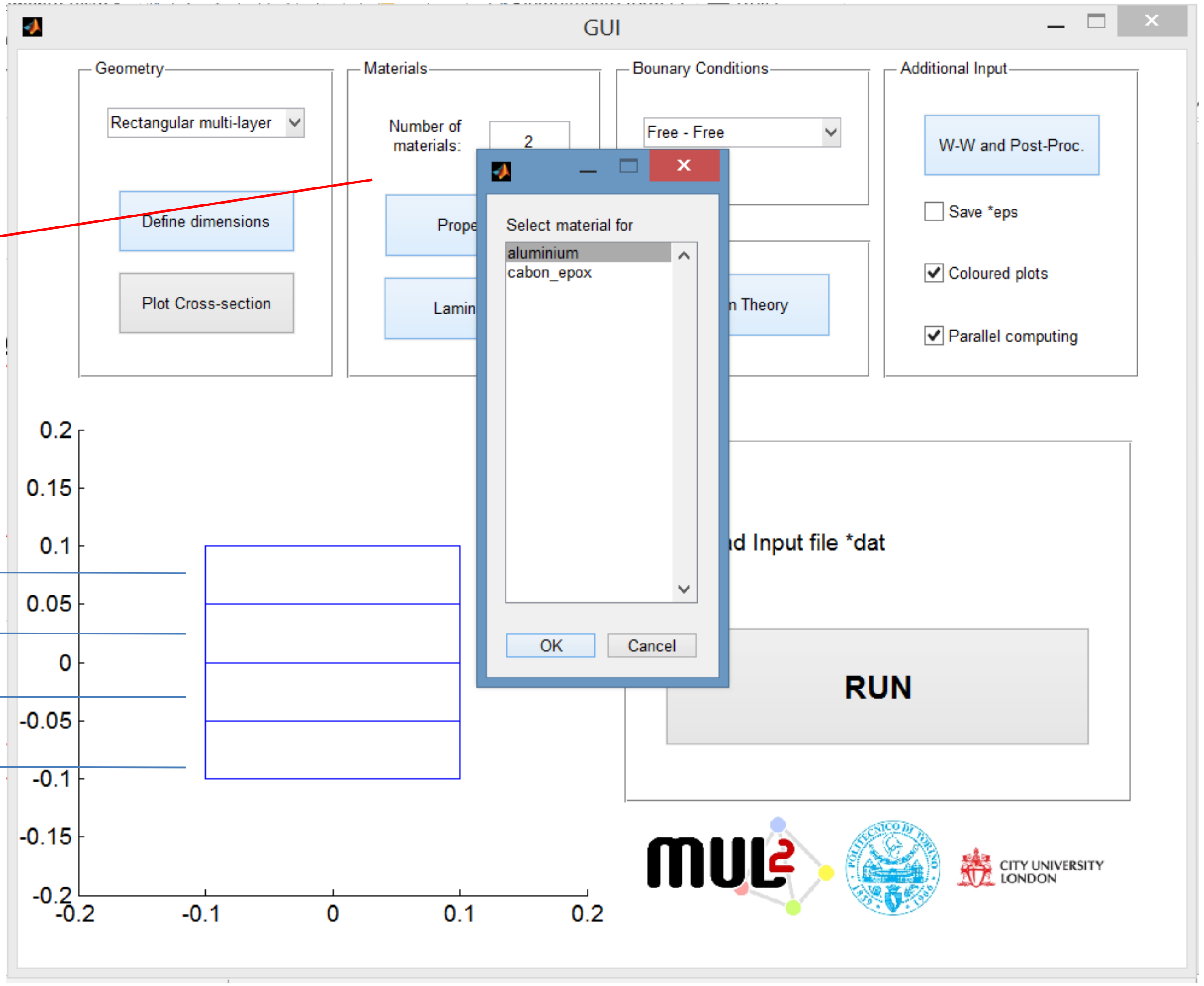


DysAAB GUI – Laminated beam

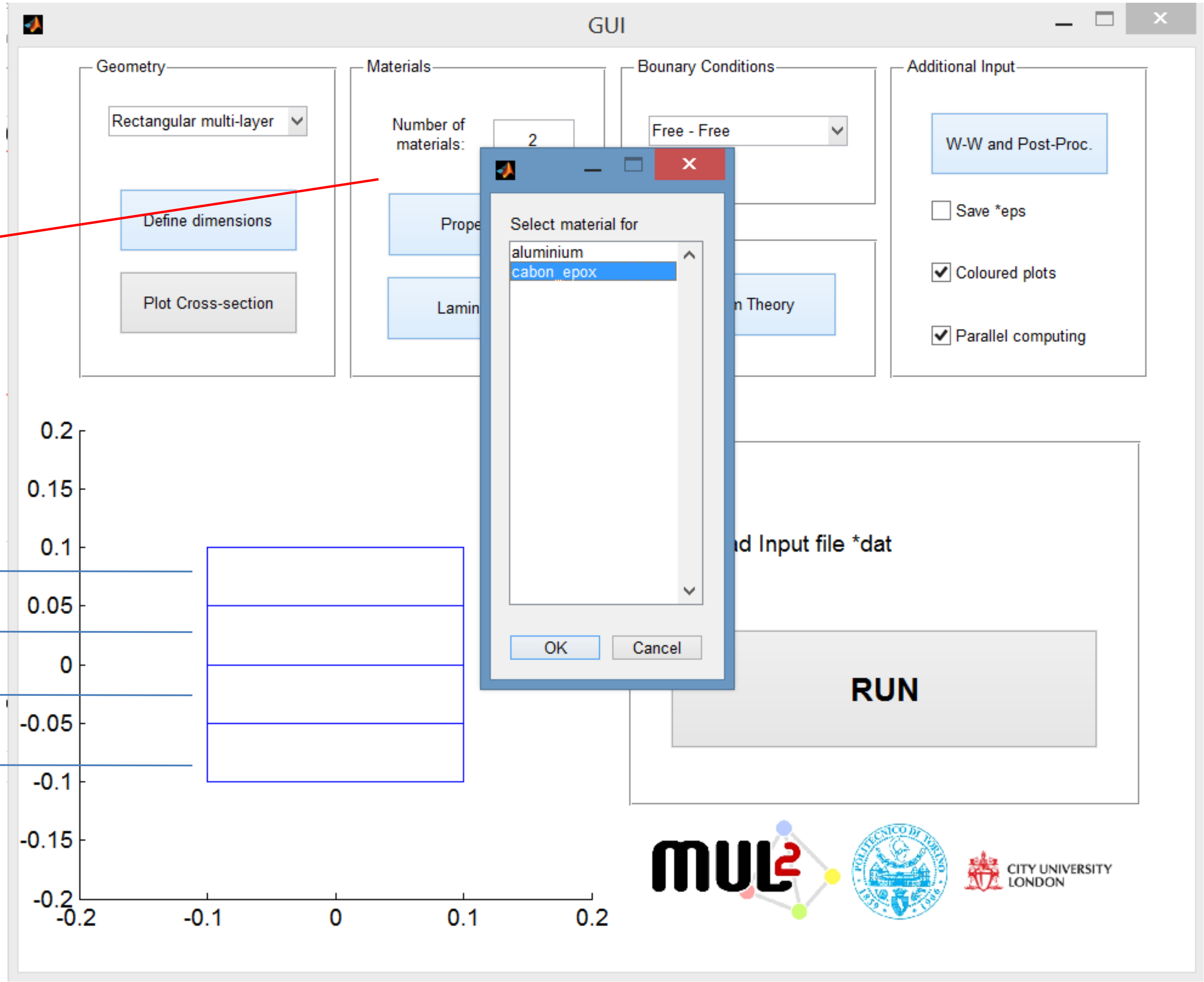
STEP 2 – Material

Lamination: define the material for layer 1

aluminium
carbon_epox (-45°)
carbon_epox (45°)
aluminium



DySAAB GUI – Laminated beam



STEP 2 – Material

Lamination: define the material for layer 2

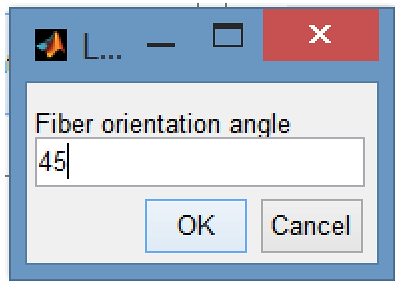
aluminium

carbon_epox (-45°)

carbon_epox (45°)

aluminium

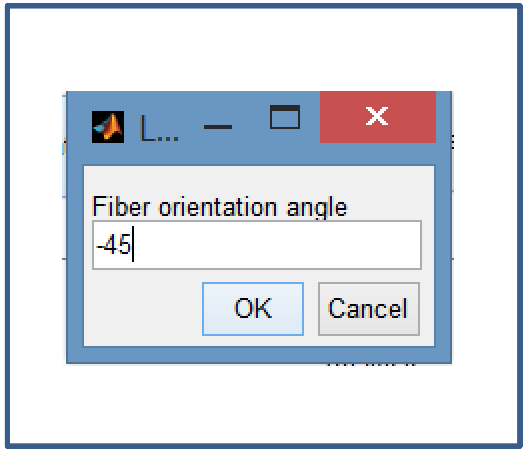
When you select an orthotropic material, a new window opens.



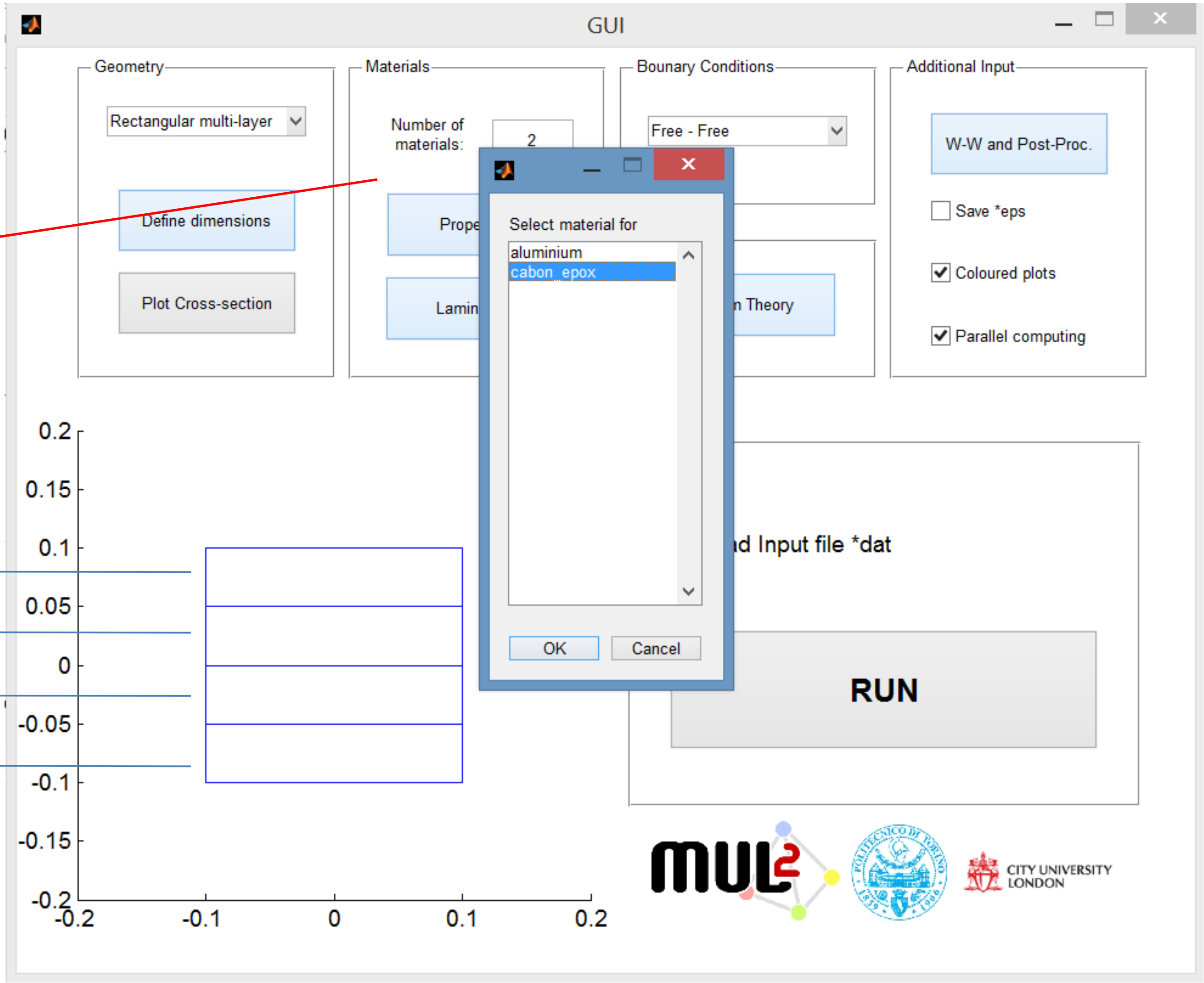
DySAAB GUI – Laminated beam

STEP 2 – Material

Lamination: define the material for layer 3



aluminium
carbon_epox (-45°)
carbon_epox (45°)
aluminium

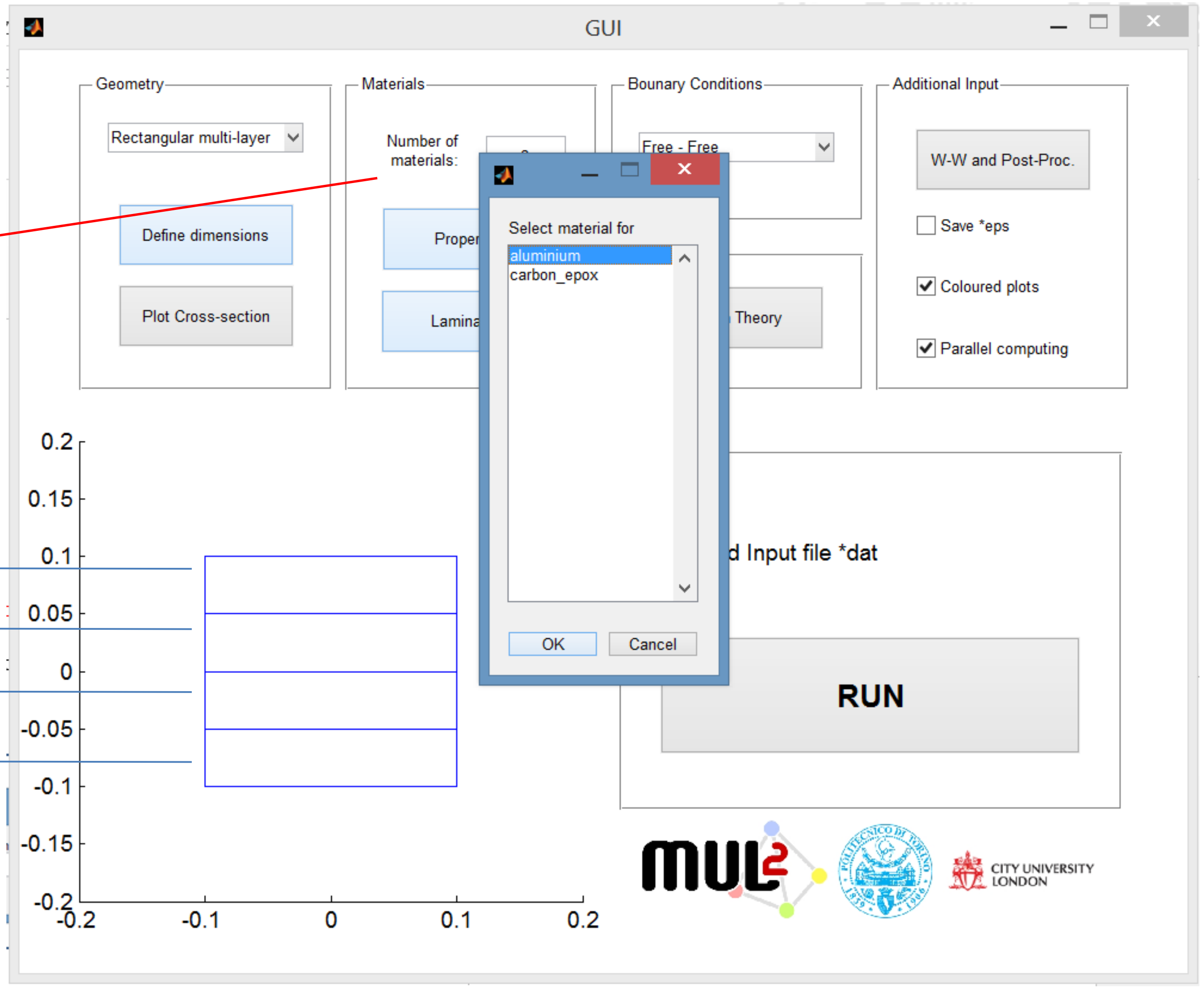


DySAAB GUI – Laminated beam

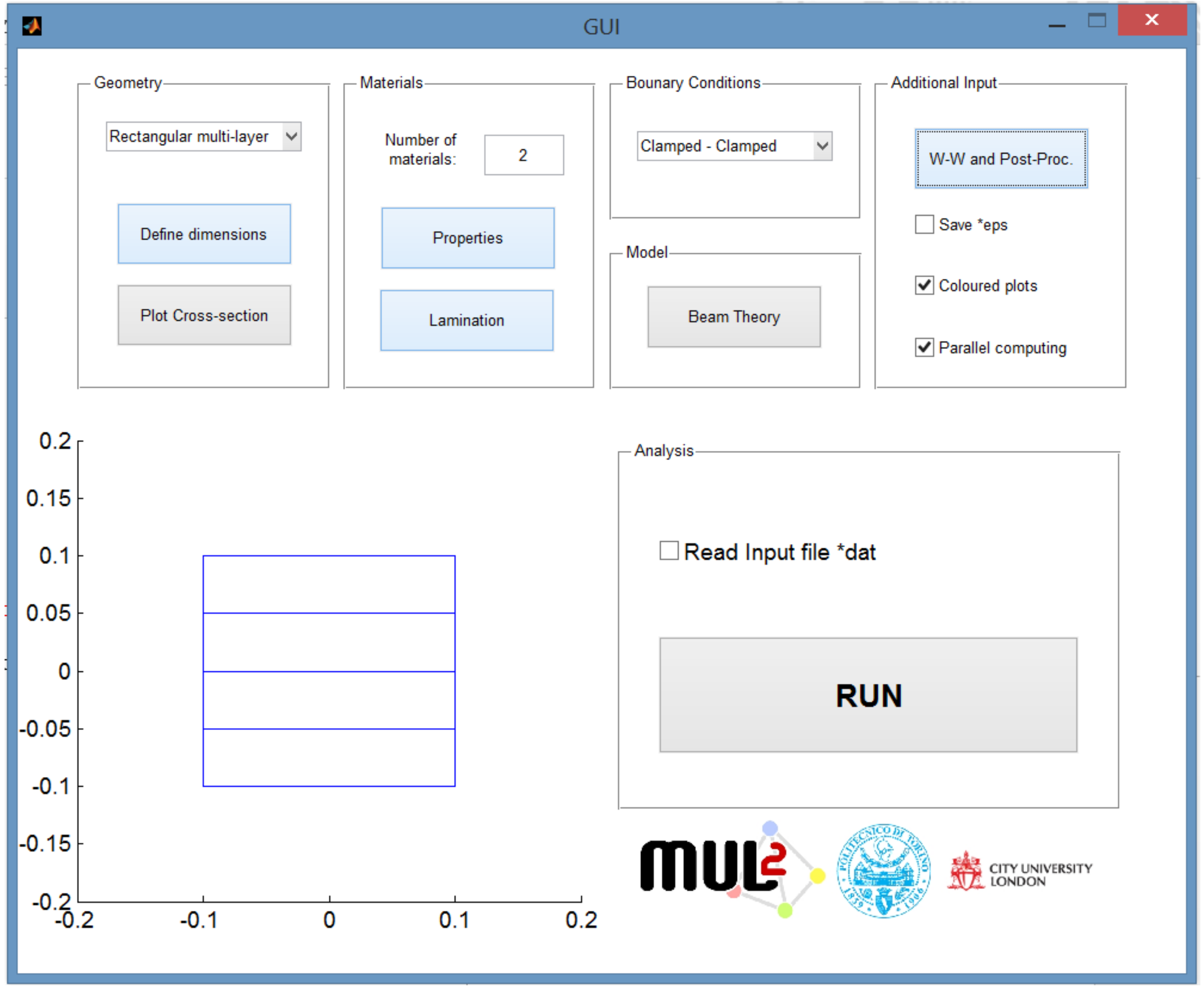
STEP 2 – Material

Lamination: define the material for layer 4

aluminium
carbon_epox (-45°)
carbon_epox (45°)
aluminium



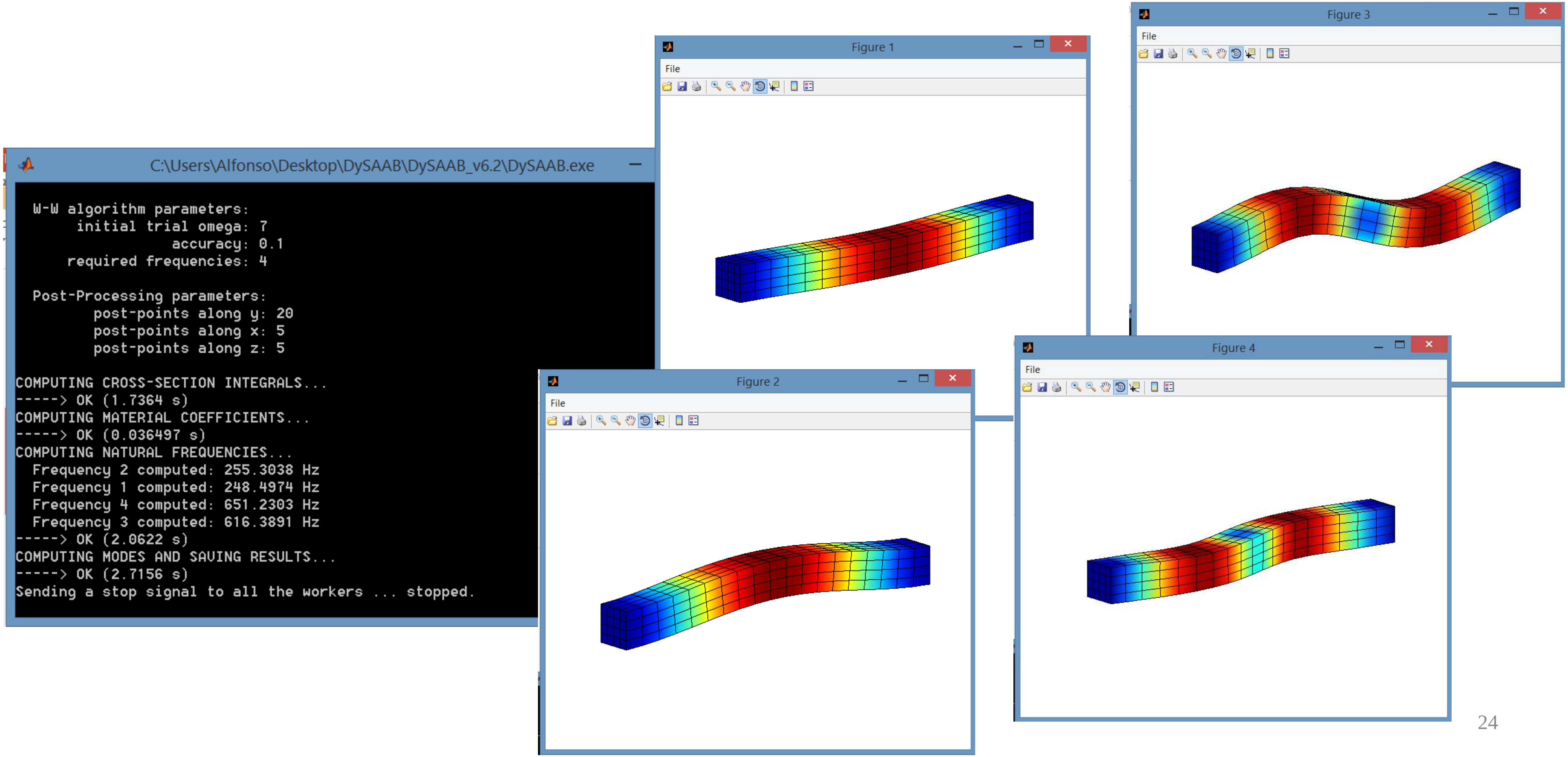
DySAAB GUI – Laminated beam



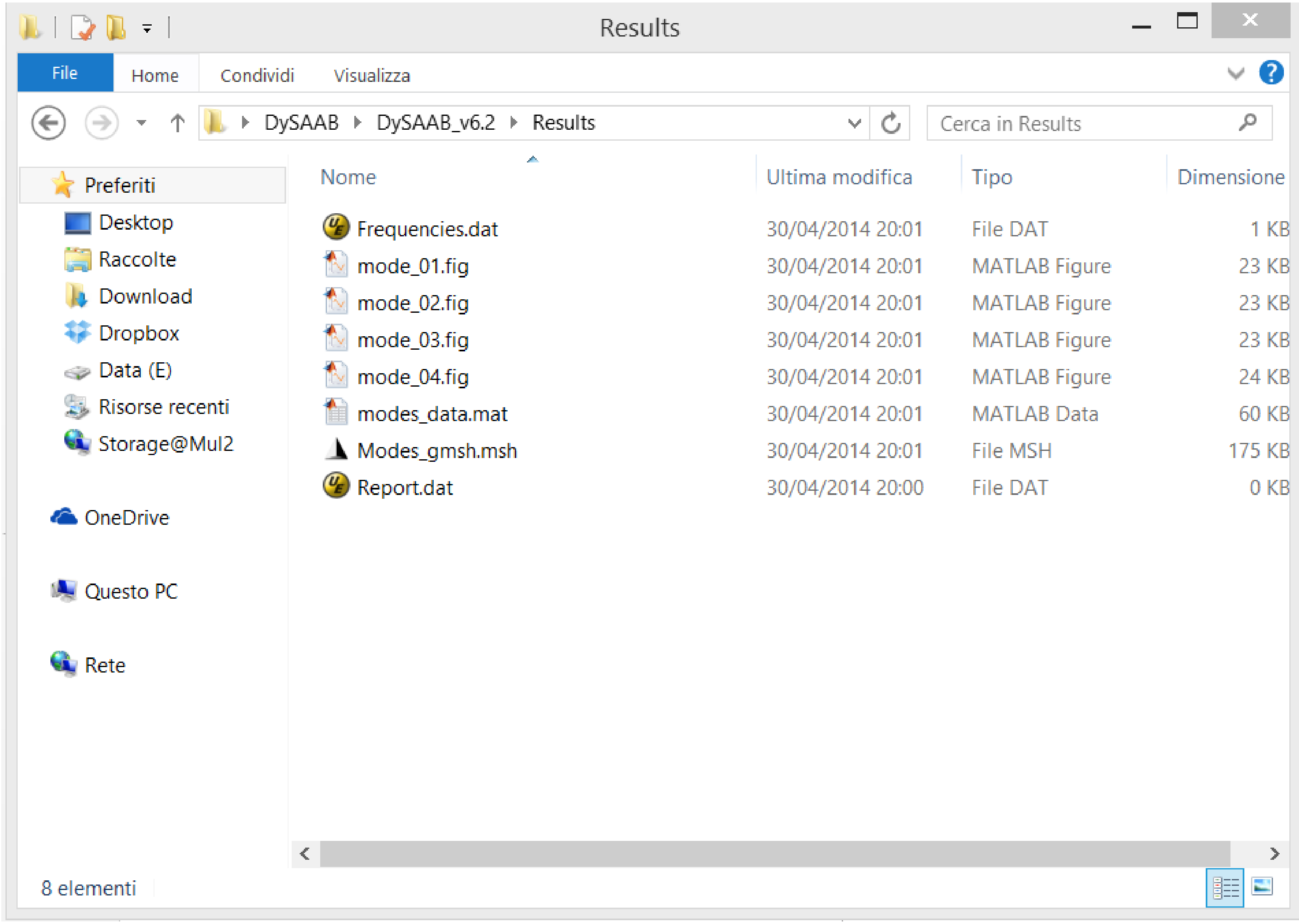
STEPS 3 to 6

As in the previous analysis case.

DySAAB GUI – Laminated beam

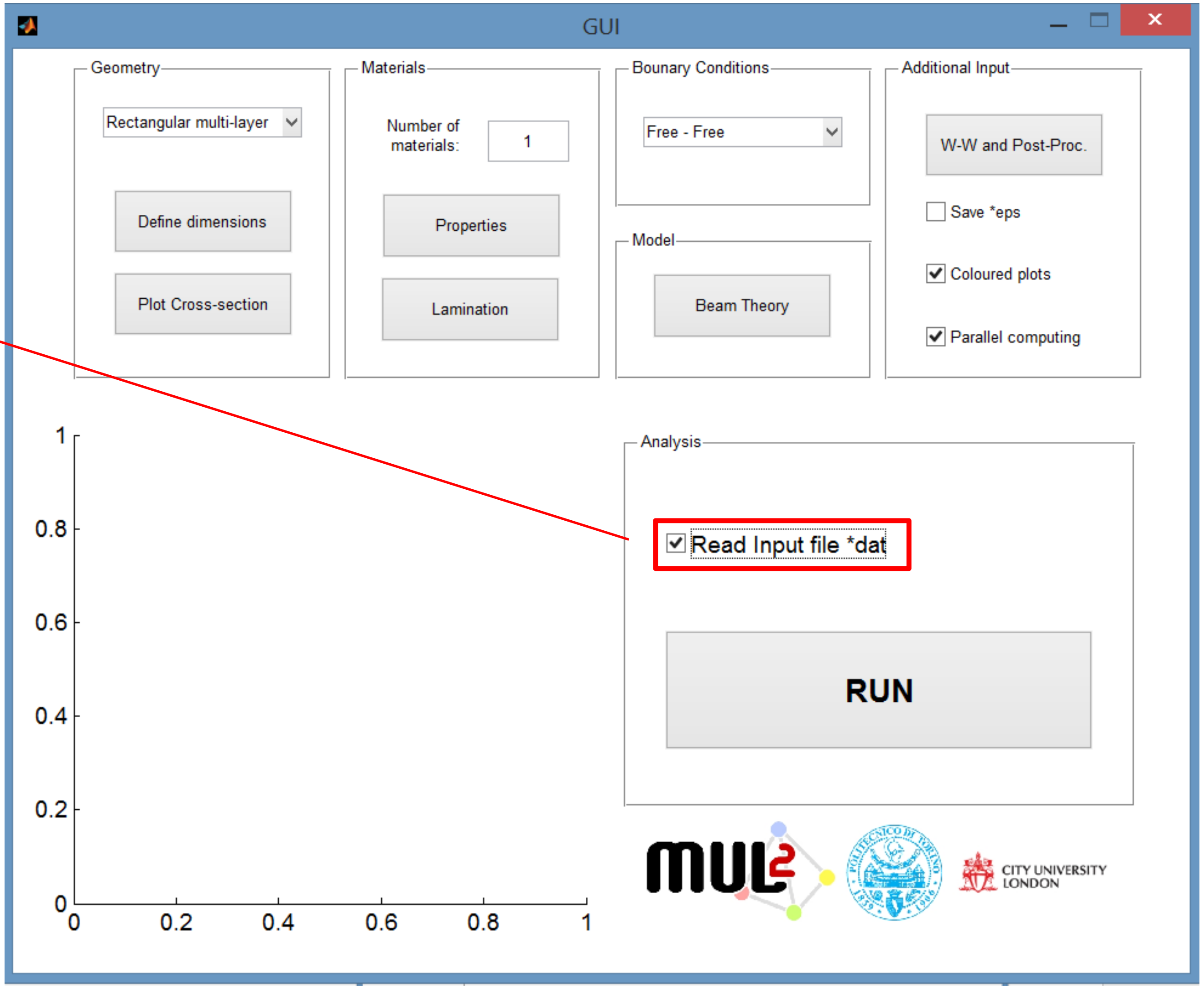


DySAAB GUI – Laminated beam



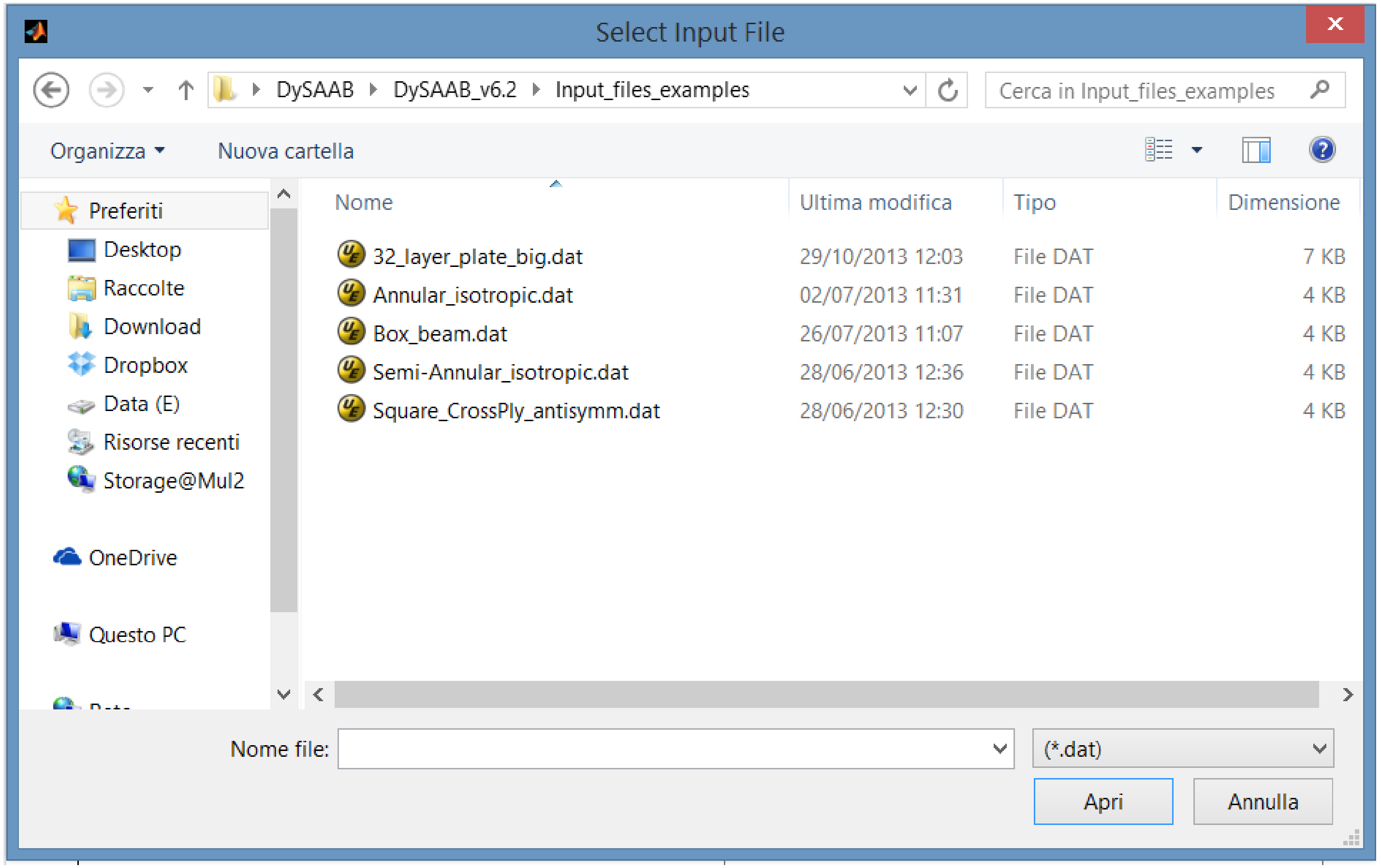
DySAAB GUI – Text data file input

If the user tick this box before pushing ‘’RUN’’ button, an input file can be read and used to running analysis.



DySAAB GUI – Text data file input

A new window opens to let the user chose the input data file.



DySAAB GUI – Text data file input

Example of input data file

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%    INPUT    %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%%%% Theory order
%% Format: N
% -> 'N': 1.1 Euler-Bernoulli beam model;
%         1.2 Timoshenko beam model;
%         1,2,3... Higher-order beam models

8

%%% Number of DS beam elements

10

%%%% Shape of the cross-section
%% Format: CS_type CS_geometry
% -> 'CS_type': 1 for Rectangular multi-layered, 2 for Isotropic C shape, 3 for Isotropic multi-layered cylinder, 4 for Isotropic rectangular box;
% -> 'CS_geometry':
%    Rectangular multi-layered ---------> width z1_bottom z1_top ... zk_bottom zk_top
%    Isotropic C shape -----------------> thickness bottom_flange top_flange vertical_left_web
%                                          (Note: bottom, top and left side are measured on the mean line of the cross-section)
%    Isotropic multi-layered cylinder --> theta_initial theta_final r1_inner r1_outer ... rk_inner rk_outer
%                                          (Note: ri_int,ri_out are the radii of the i_th layer; theta_in is the angle where the cylinder starts (in d
%    Isotropic Rectangular Box ---------> width height thickness

1 296.5 -3.083328 -2.89062 -2.89062 -2.697912 -2.697912 -2.505204 -2.505204 -2.312496 -2.312496 -2.119788 -2.119788 -1.92708 -1.92708 -1.734372 -1.73

%%%% Length of the beam

559

%%%% Boundary Conditions
%% Format: bcs
% -> 'bcs': FF for Free-Free boundary conditions;
%         CF for Clamped-Free boundary conditions;
%         SS for Simply supported boundary conditions. Etc.

FF
```