

The University of Iowa
College of Engineering
53:236 Optimization of Structural Systems
Fall Semester 2004

Assignment #3:

Due: 10/20/2004

In this assignment, you will use the finite element code FENDAC and the optimization program SLP to get some experience with the characteristics of continuum structural topology optimization. These tools will be exercised to solve the so-called MBB Beam problem shown below:

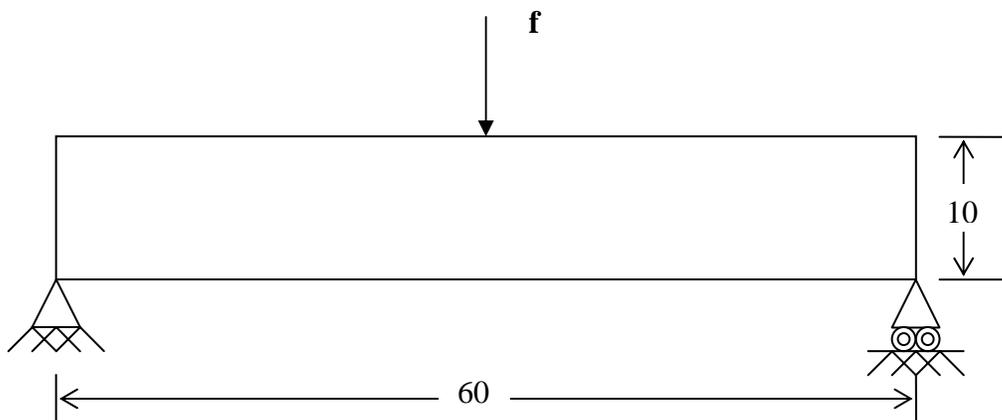


Fig. 1. MBB Beam problem structural domain, support conditions, and loading case.

The specific assignment is as follows:

Using a Q4/Q4 SIMP formulation find the optimal “design” of the structure that minimizes the linear elastic compliance under the loading shown, subject to a material usage constraint $\langle \phi_{solid} \rangle \leq 0.25$. Solve the problem three times, each time using one of the following values of $pglob$: 1.0; 0.5; 0.0. Note that $pglob$ is related to the powerlaw exponent p as follows: $p = 1 + 3 * (1 - pglob)$. For each value of $pglob$ solve the design problem with two different starting conditions: $b_i = 1.0$ for all i and $b_i = .25$ for all i . Discuss in detail the influence of the powerlaw value p and the starting design values on the designs you obtain. Include pictures of your optimal structural designs with the work you turn in.

To execute the finite element program FENDAC and to interpret its results, you will need to carefully step through the following process:

1. Log on to any ITANIUM ICAEN HP-UX work station.
2. To make sure you're running in a unix C-shell, type: `csch [Enter]`

3. Download the FEM data file typing:
`cp /usr/ui/class/examples/cee5330/53_236/hw3/des.data .`
4. Download a shell script by typing:
`cp /usr/ui/class/examples/cee5330/53_236/hw3/setup53236 .`
5. Execute this setup shell script by typing: `source setup53236 [Enter]` (Note that you will need to re-execute this shell script each time you log in.)
6. Edit `des.data` so that it runs in data checking mode. Execute the finite element program (FENDAC) by typing: `fhp-m [Enter]` The program will then prompt you for the name of the data file. In response, type: `des [Enter]` The finite element program (FENDAC) will execute in the background. Wait for the program to finish executing (This should take a maximum of about 60 seconds). After executing the program, you will have a file called `DESVAR_MAP` in your directory in addition to a number of `TAPE** .des` files which contain information for the post-processing software.
7. Edit `des.data` so that it runs in execution mode.
8. Edit the `ides.inp` file as needed.
9. Begin the optimization process by typing `SLP [Enter]` .
10. Your evolving design results can be viewed onscreen by executing the program `ropostg` as follows: `ropostg des [Enter]`