



# **LCFI Interim results**

## **The Mechanical Design Aspects**

**by**

**Oxford University**



# LCFI Interim results

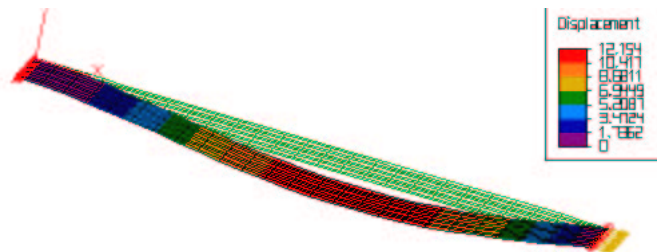
The aim of this exercise is to:

- Bench marking the FEA results before the launch of the complex non-linear runs;
- Examine the natural frequencies of the CCD with and without the pre-tension load;
- Examine the change in static deflection due to the pre-tension load;
- Examine the response of the CCD due to a dummy flow induced pressure pulse;

# LCFI Interim results

Bench marking the FEA results:-

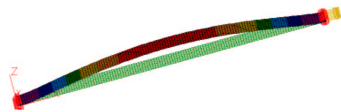
Under a self weight load only, the FEA shows a static deflection of 12.154mm



The classical method produces a result of 12.32mm.

# LCFI Interim results

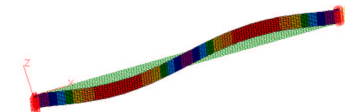
Natural frequencies of the CCD with and without the pre-tension load:



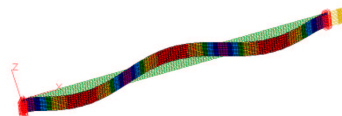
**Mode 1: Bending**  
5.08Hz - without tension  
42.4Hz - with tension  
41.35Hz - classical sol.



**Mode 2: Twisting**  
16.5Hz - without tension  
67.0Hz - with tension



**Mode 3: Bending**  
33.6Hz - without tension  
85.4Hz - with tension  
82.7Hz - classical sol.



**Mode 4: Bending**  
57.5Hz - without tension  
129.7Hz - with tension  
124Hz - classical sol.

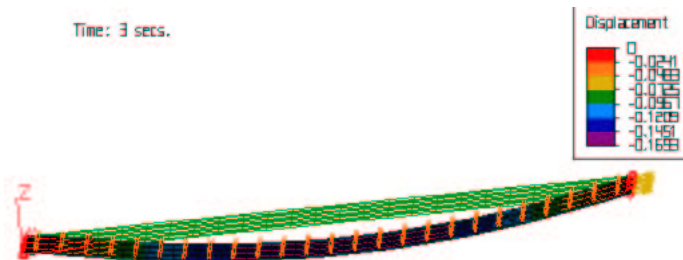


**Mode 5: Twisting**  
88.0Hz - without tension  
135Hz - with tension

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Changes in static deflection due to a pre-tension load:

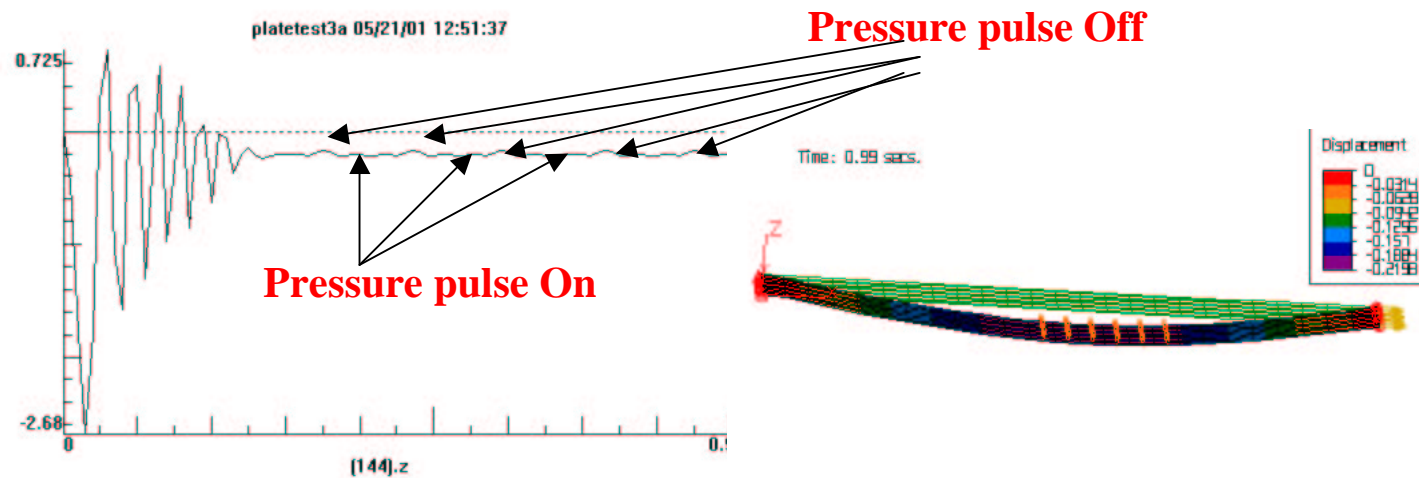
A non-linear analysis was applied to account for the increase in stiffness due to an end load, the total deflection due to a combination of self-weight load and a pre-tension of 150g is 0.169mm.



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- Examine the response of the CCD due to a dummy flow induced pressure pulse:

for a +ve pressure pulse of 0.01 mbar, the max. deflection increases from 0.169mm to 0.215mm





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## Observation

- With the pre-tension fully applied, a pressure pulse as small as 0.01mbar will cause the CCD to vibrate at a magnitude of approximately 50 micron.
- The next step is to model the flow characterer and to establish the flow pattern to see how the CCD responses.
- The results indicate that further tensioning may be necessary if we were to reduce the level of vibration to achieve a more stable read-out.
- The first natural frequency of the tensioned CCD is now approaching 50Hz which is the noisy frequency of most motor driven machinery of the surrounding area. Should this frequency be avoid?