Comparison of FLUID29 and FLUID79 Elements

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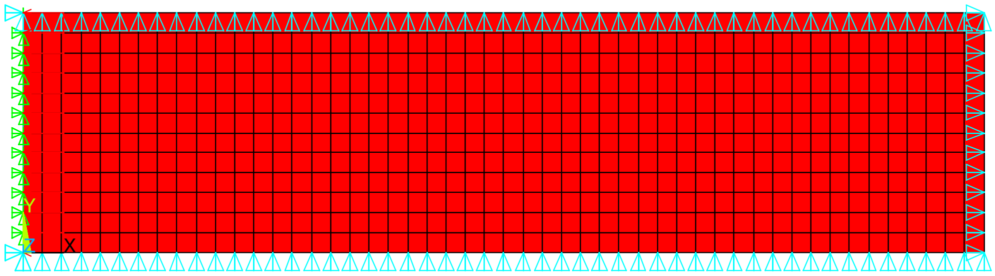
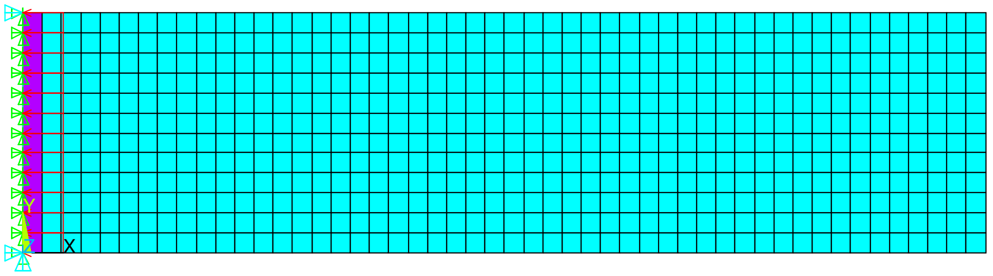
Analyses were conducted to verify that similar results could be obtained by using the displacement formulated fluid elements `FLUID79` or the pressure formulated fluid elements `FLUID29`.

The model under investigation was a 2 dimensional rectangular cavity with 3 rigid walls and a flexible aluminium panel on one side. The following picture shows the model that used the `FLUID79` elements.



The edges along the top, bottom and right hand side were constrained from moving in the normal direction. The tangential degree of freedom was unconstrained. The panel on the left hand side of the structure was modelled using `BEAM3` elements and was simply supported at the top and bottom nodes. A double layer of `BEAM3` elements was used so that a harmonic pressure could be applied to the exterior of the structure. The technique of using a double layer of coincident elements is described in detail in the report titled "Coupled Structural - Acoustic Analysis Using Ansys". The dimensions of the cavity were 0.5m $\times$ 2m and the element size was 0.4m, which corresponds to 21 elements per wavelength at 400Hz.

Another model was created using the pressure formulated fluid elements `FLUID29`. The model is shown below.



As previously described, a double layer of coincident beam elements was used to model a simply supported aluminium panel. A harmonic pressure of 1Pa was applied to the nodes associated with beam elements on the exterior of the structure, and the sound pressure level inside the cavity was calculated. To apply the loads to the beam elements, need to use the command

```
sfbeam,all,,pres,1
```

The material properties for the `fluid29` elements are:

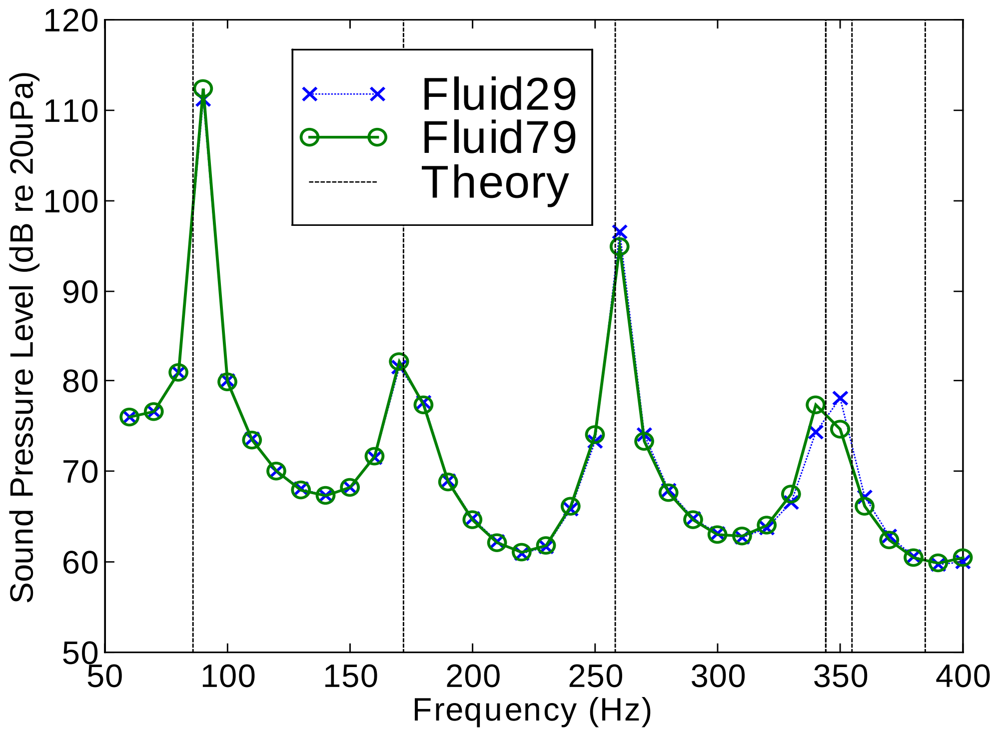
```
MP, EX,   1, 0.14319E+06
MP, DENS, 1, 1.2100
MP, SONC, 1, 344.00
```

Sound Pressure Level Comparison Between Using FLUID29 and FLUID79 elements

The average sound pressure level inside the rectangular box was obtained by averaging the sound pressure level over the 600 elements (which are all the same size) inside the cavity.

$$L_{pav} = 10\log_{10}\left(\left(\sum_i 10^{L_{pi}/10}\right)\frac{1}{600}\right)$$

The following figure shows the average sound pressure level inside the cavity for the model that used the `FLUID29` and the `FLUID79` elements.

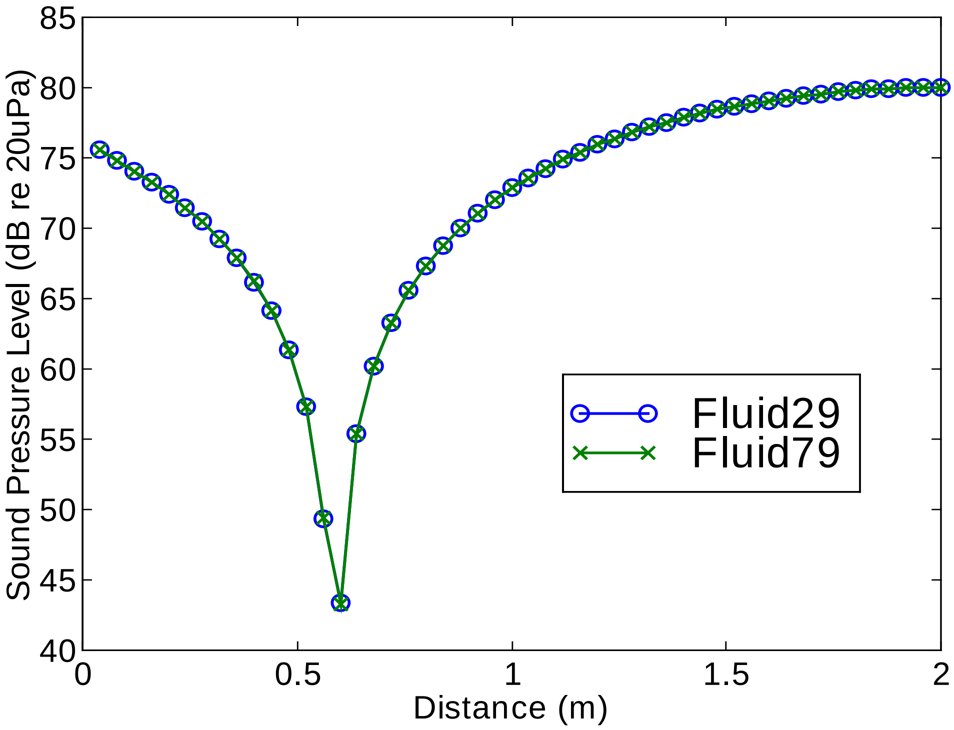


The theoretically calculated resonance frequencies are drawn on the graph as vertical dashed lines and were calculated using the formula

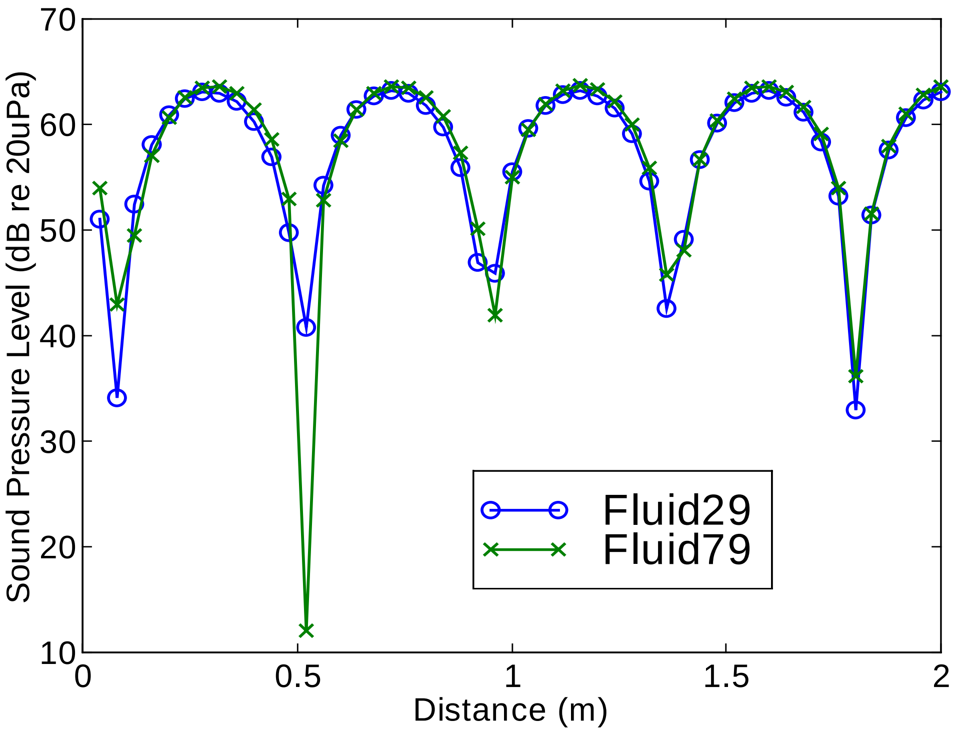
$$f_{mn} = \frac{1}{2\pi}\frac{c}{2}\sqrt{\left(\frac{m}{L_x}\right)^2 + \left(\frac{n}{L_y}\right)^2}$$

where f_{mn} is the frequency of the m,n mode in Hertz, L_x and L_y are the dimensions of the cavity in metres.

The sound pressure along the mid-height of the cavity (y=0.25m) at 60Hz is shown in the following figure.



The sound pressure level at 400Hz is shown below.



These two results show there is some slight discrepancies between the two models at the higher frequency.