Structural responses of an arbitrary wire

The number of waves that pass a fixed point in unit time; also, the number of cycles or vibrations undergone during one unit of time by a body in periodic motion.

Attached below are the analytical calculations for the twisted wire, taking its mass to be 0.5 kg and the concentrated mass to be of 0.3 kg. The steel wire depicts a specific elastic constant which is used in the calculations.

Vibration Frequency of first mode ; just wire

(1) Used formulas are :-

i) $$\bar{\nu} = \frac{1}{2\pi c} = \sqrt{\frac{K}{\mu}}$$

π = pi constant = 3.14

c = Speed of light

K = Constant

μ = reduced mass (only wire)

On putting values we get :-

$$\nu = \frac{1}{2\times 3.14\times 3\times 10^{8}} \times \sqrt{\frac{5\times 10^{3}}{0.5}}$$

$$K = \frac{EA}{L}$$

$E \Rightarrow$ Elastic modulus

$A \Rightarrow$ cross sectional area

$L \Rightarrow$ length of wire

$$\bar{\nu} = \frac{100}{6.28 \times 3\times10^8}$$

$$= \boxed{5.307\times10^{-8}}$$

ii) Wire with concentrated mass:

Now; we have

$$\bar{\nu} = \frac{1}{2\pi c} \times \sqrt{\frac{K}{\mu}}$$

$\mu = m + m_0 =$ (both masses added)

$$\bar{\nu} = \frac{1}{6.28\times3\times10^2} \times \sqrt{\frac{5\times10^3}{0.8}}$$

$$= \frac{79.05}{6.28\times3\times10^8} = \boxed{4.2\times10^{-8}}$$

For the second part, we have attached results from Abaqus, pertaining to the requirements of the task.

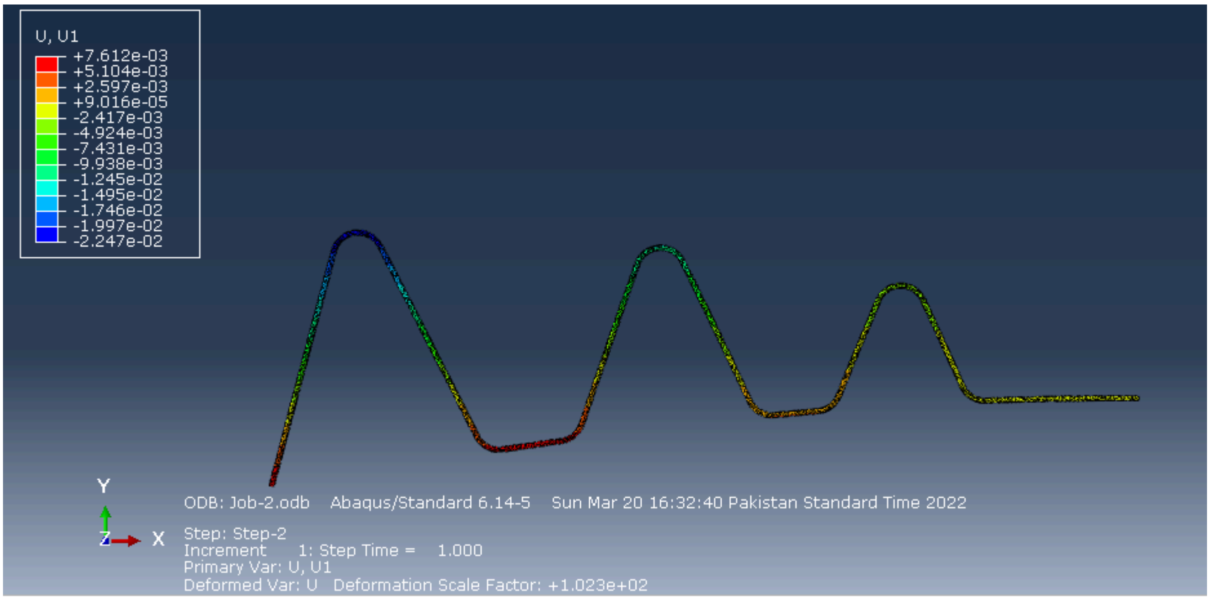

Figure 1-displacement 1

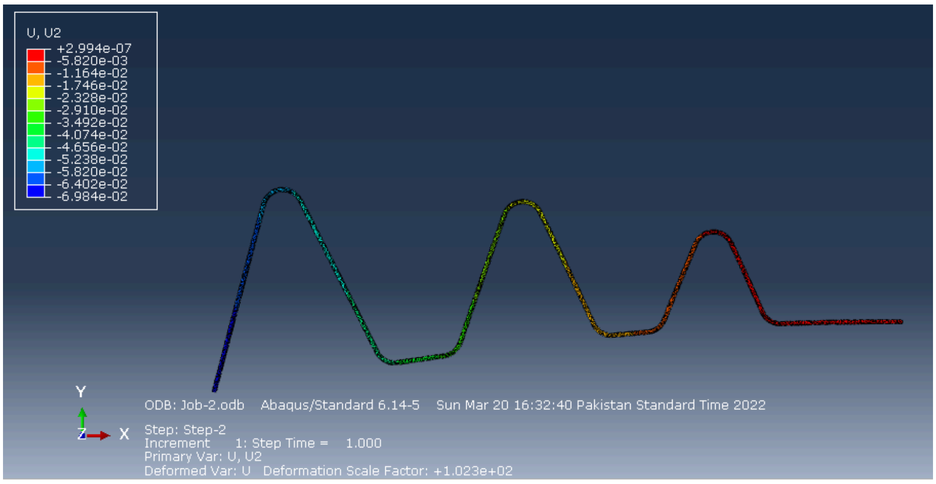

Figure 2-displacement 2

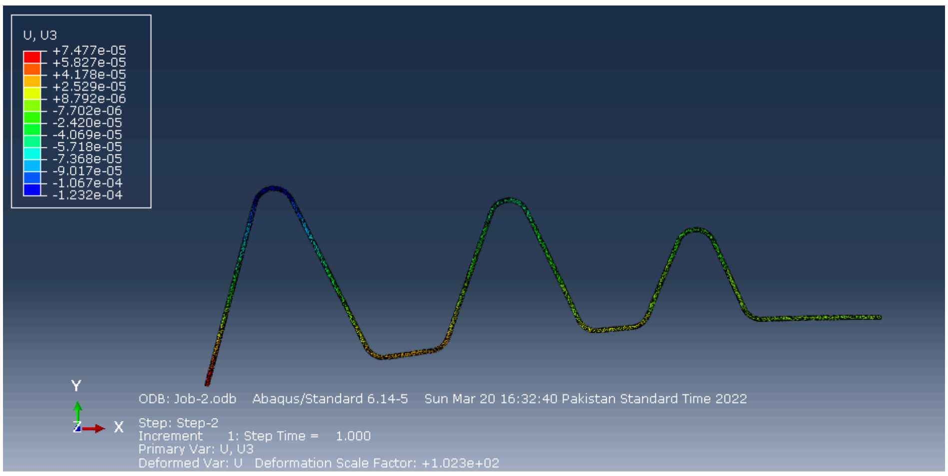

Figure 3-displacement 3

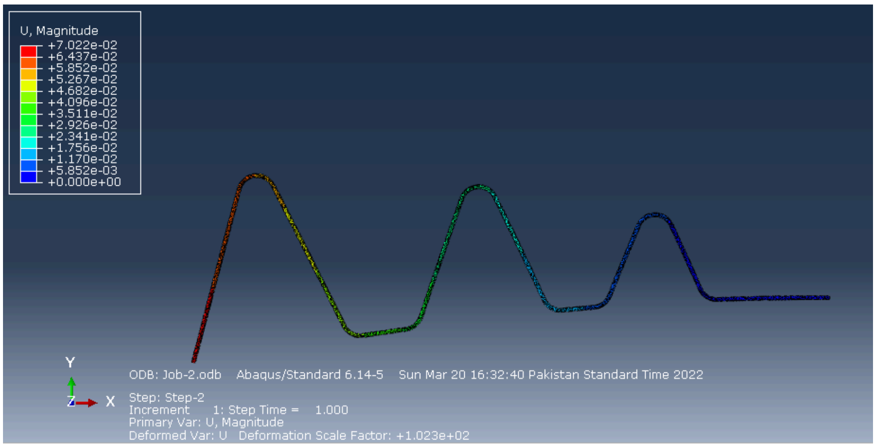

Figure 4-displacement 4

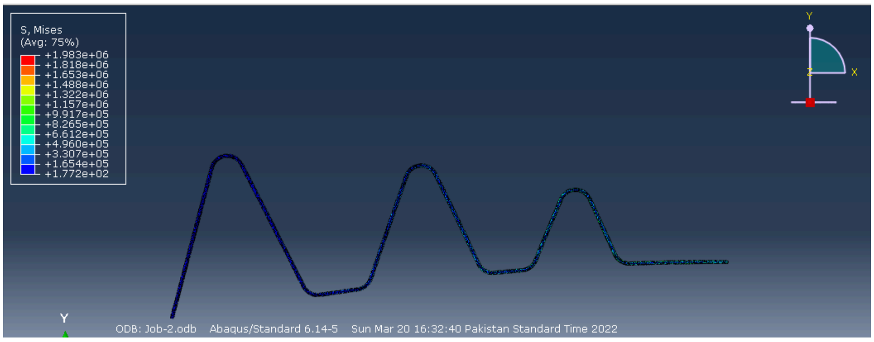

Figure 5-von mises stress

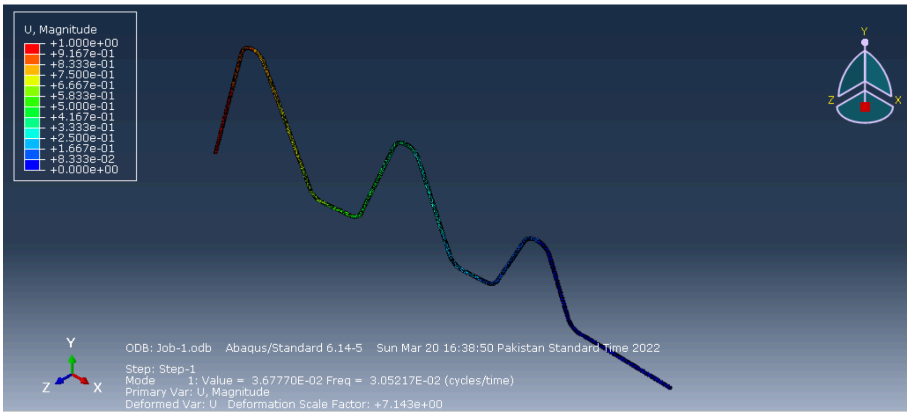

Figure 6-mode 1 results

Now for the second part, where the concentrated mass is also attached with the wire, the results become as:

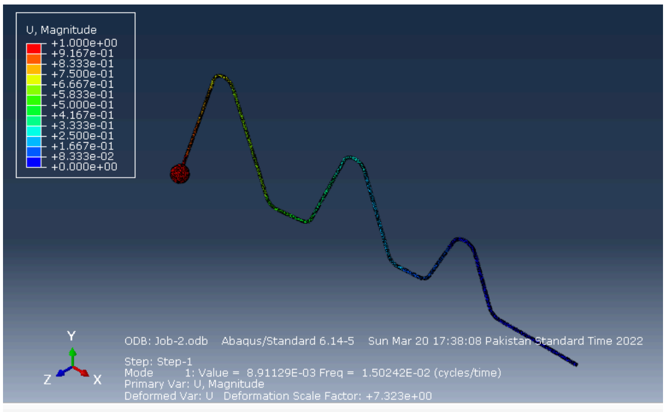

Figure 7-vibrational analysis with mass attached