AIM Cantilever Beam Modal Analysis - Pre-Analysis & Start-Up

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Pre-Analysis & Start-Up

Pre-Analysis

The following equations give the frequencies of the modes and the mode shapes and are derived from Euler-Bernoulli Beam Theory.

$$w_n = \alpha_n^2 \sqrt{\frac{EI}{ml^3}}$$

$$n = 1, 2, 3, ...$$

$$\alpha_n = 1.875, 4.694, 7.855, ...$$

$$m = \rho V = \rho \cdot l \cdot h \cdot w$$

$$I = \frac{w \cdot h^3}{12}$$

$$w_1 = 1.875^2 \sqrt{\frac{70\ E9\ \frac{kg}{m \cdot s^2} \cdot \frac{0.346m \cdot (0.346m)^3}{12}}{2.7\ E3\ \frac{kg}{m^3} \cdot 4m \cdot 0.346m \cdot 0.346m \cdot (4m)^3}} = 111.7\ \frac{rad}{s} = 17.8\ Hz$$

$$w_2 = 4.694^2 \sqrt{\frac{70\ E9\ \frac{kg}{m \cdot s^2} \cdot \frac{0.346m \cdot (0.346m)^3}{12}}{2.7\ E3\ \frac{kg}{m^3} \cdot 4m \cdot 0.346m \cdot 0.346m \cdot (4m)^3}} = 700.4\ \frac{rad}{s} = 111.5\ Hz$$

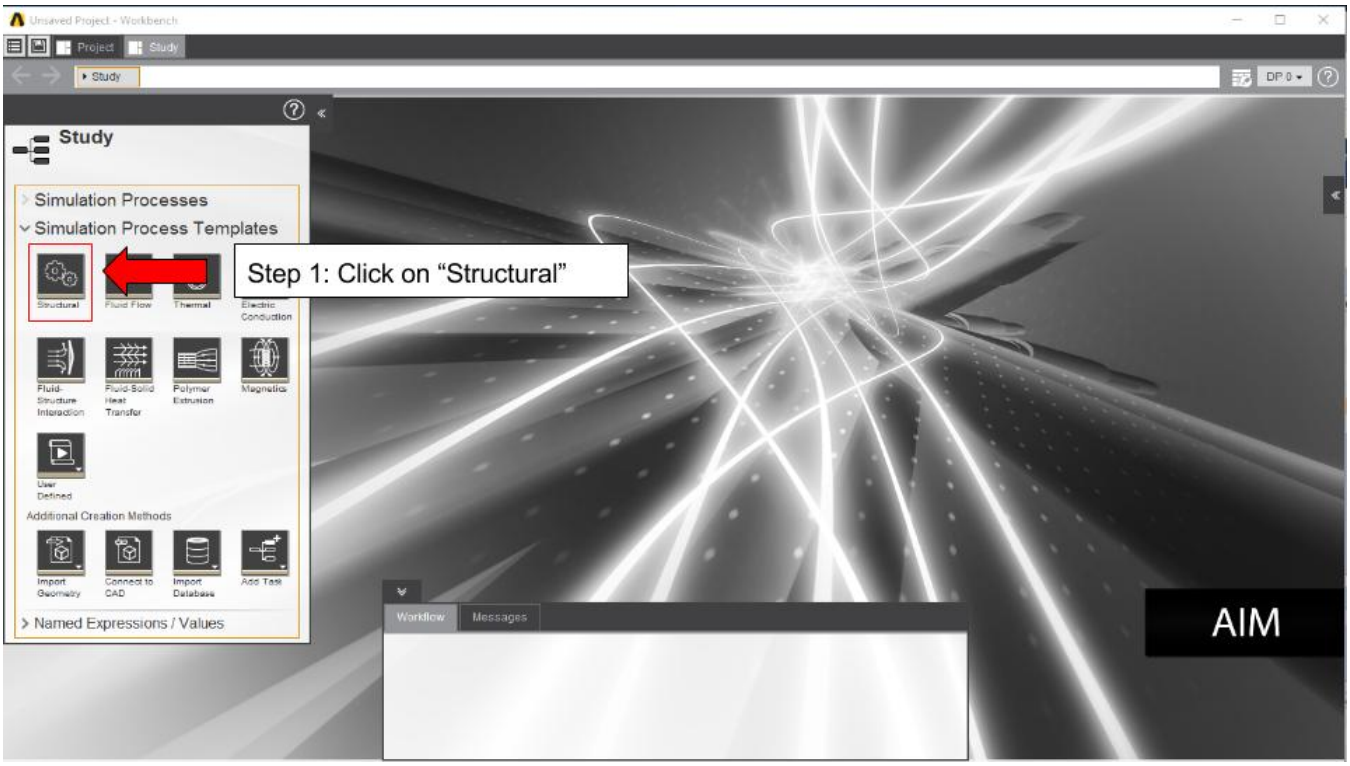
$$w_3 = 7.855^2 \sqrt{\frac{70\ E9\ \frac{kg}{m \cdot s^2} \cdot \frac{0.346m \cdot (0.346m)^3}{12}}{2.7\ E3\ \frac{kg}{m^3} \cdot 4m \cdot 0.346m \cdot 0.346m \cdot (4m)^3}} = 1961.2\ \frac{rad}{s} = 312.1\ Hz$$

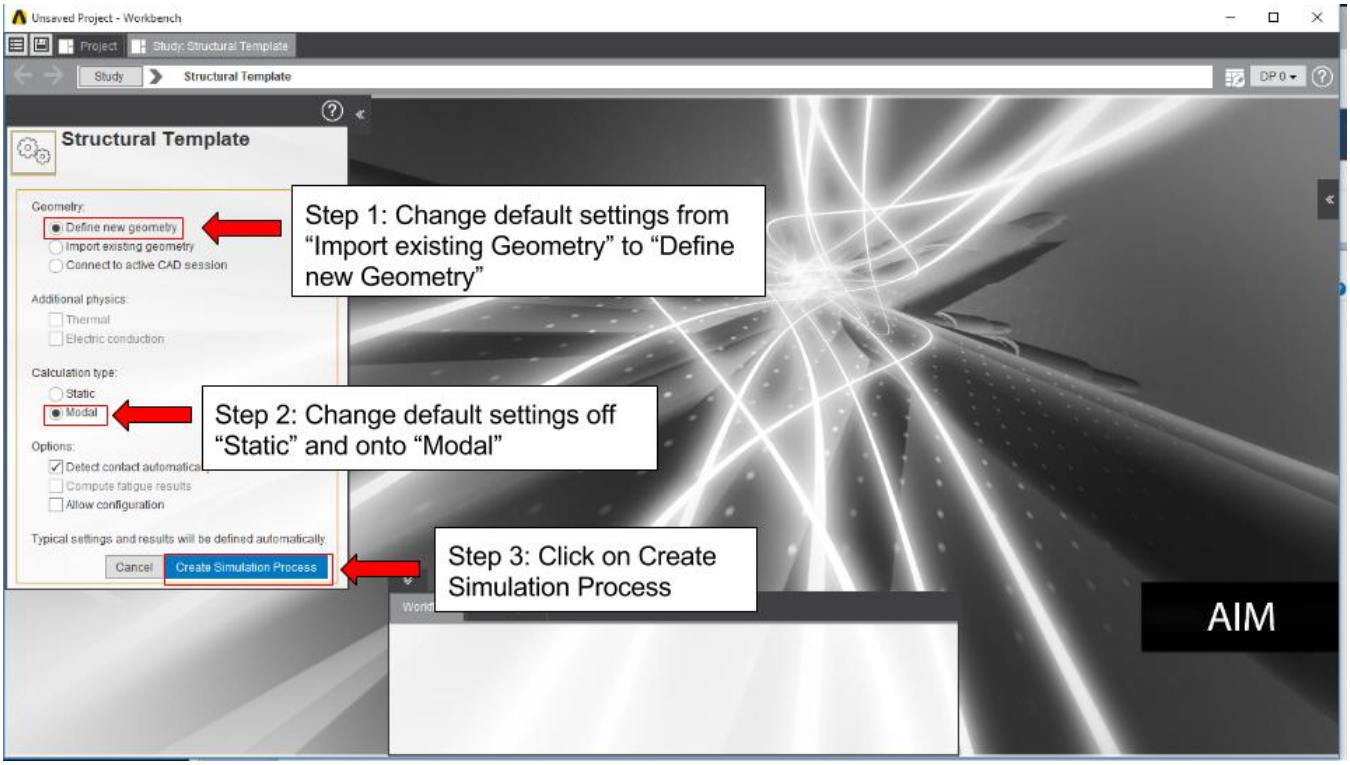
$$y_i(x) = cosh(\frac{\alpha_i x}{L}) - cos(\frac{\alpha_i x}{L}) - \sigma_i(sinh(\frac{\alpha_i x}{L}) - sin(\frac{\alpha_i x}{L}))$$

$$\alpha_i = 1.875, 4.694, 7.855, ...$$

$$\sigma_i = 0.73409,\ 1.018647,\ 0.9992245,\ ...$$

Start-Up





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