

Smart Structures Project 1:

Design and Simulation of a Piezoelectric Stack Actuator

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Problem: Design a piezoelectric stack actuator such that it can produce a minimum blocked force and free displacement of 50 N and 4 mm, respectively, when a voltage signal of 15 V is applied to the stack. The material and geometry properties of each piezoelectric layer (PZT-5H) is shown in table 1

- Determine the minimum number of required layers and the total length of the stack.
- Plot the response of the system when the voltage signal is sinusoidal with the excitation frequency of $f = 500 \text{ Hz}$.

Table 1. Material and geometry properties of one PZT-5H layer

Length, t_p (mm)	0.5
Width, $\hat{b}_p$ (mm)	5
Thickness, $\hat{t}_p$ (mm)	2
Axial compliance, $s_{33}^E(\frac{m^2}{N})$	16.5×10^{-12}
Shear compliance, $s_{55}^E(\frac{m^2}{N})$	43.5×10^{-12}
Density, $\rho_p(\frac{kg}{m^3})$	7500
Piezoelectric constant, $d_{33}(\frac{C}{N})$	593×10^{-12}

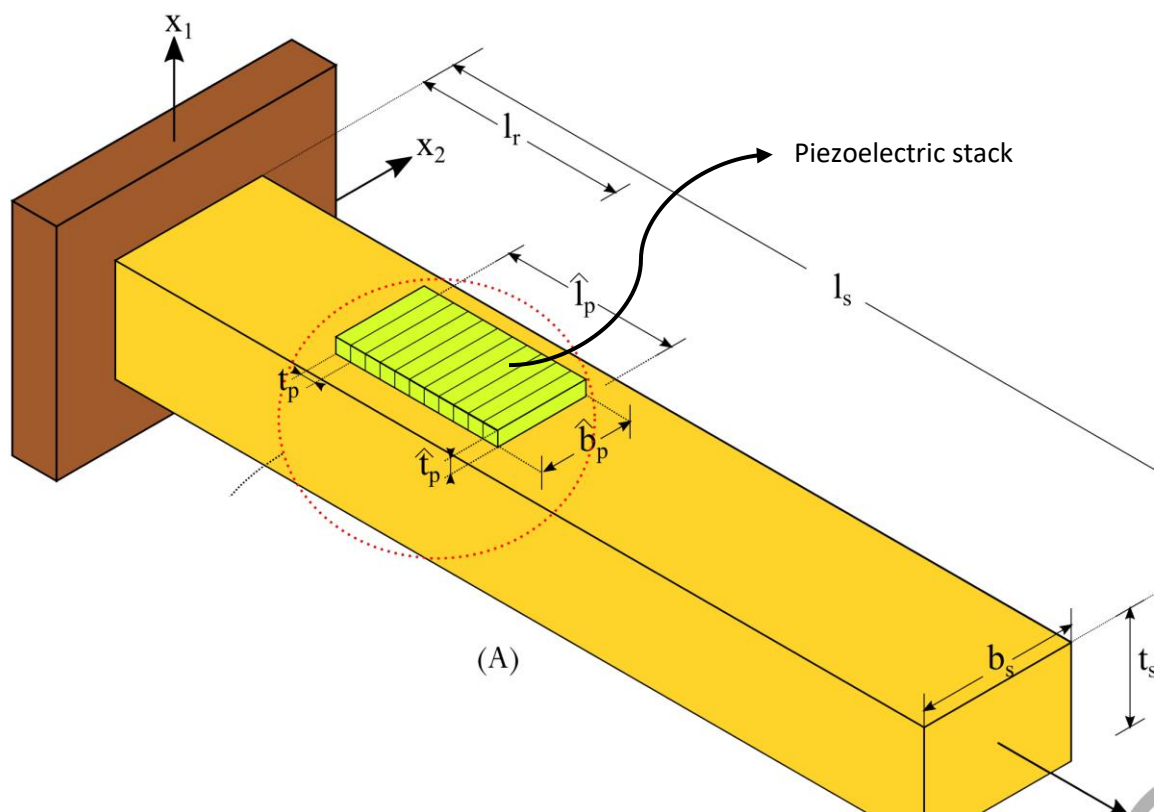


Figure 1. Schematic of the piezoelectric stack actuator