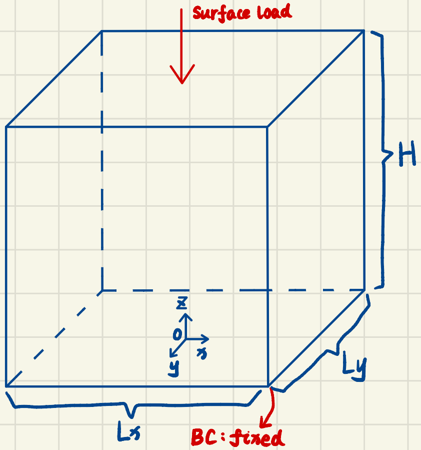
HW 1 Yu Niu 8/31/2025



Q1:

Assumption:

- The bearing has dimensions of L_x, L_y, and H in the x, y and z directions.
- The top surface is subject to compression, while the bottom surface is fixed.

Displacement field function:

$$w(x,y,z) = -\frac{\Delta}{H}z + A\sin\left(\frac{\pi z}{H}\right)\cos\left(\frac{\pi x}{L_x}\right)\cos\left(\frac{\pi y}{L_y}\right)$$

- Δ is the vertical compression displacement at $z=H$
- A is the bulging amplitude coefficient, determined by experiments or assumptions.
- $-\frac{\Delta z}{H}$ represents uniform compression:

  when $z=0$, $-\frac{\Delta z}{H}=0$; when $z=H$, $-\frac{\Delta z}{H}=-\Delta$
- $A\sin\left(\frac{\pi z}{H}\right)\cos\left(\frac{\pi x}{L_x}\right)\cos\left(\frac{\pi y}{L_y}\right)$ represents bulging

  when $z=0$, $A\sin\left(\frac{\pi z}{H}\right)\cos\left(\frac{\pi x}{L_x}\right)\cos\left(\frac{\pi y}{L_y}\right)=0$
  (the bulging effect is 0)

  when $z=H$, $A\sin\left(\frac{\pi z}{H}\right)\cos\left(\frac{\pi x}{L_x}\right)\cos\left(\frac{\pi y}{L_y}\right)=0$
  (the bulging effect is 0)

  when $z=\frac{H}{2}$, $A\sin\left(\frac{\pi z}{H}\right)\cos\left(\frac{\pi x}{L_x}\right)\cos\left(\frac{\pi y}{L_y}\right)= A\cos\left(\frac{\pi x}{L_x}\right)\cos\left(\frac{\pi y}{L_y}\right)$
  (the bulging effect is the largest)

  when $x=0$ or $y=0$ (in middle), $\cos\left(\frac{\pi x}{L_x}\right)=1$ or $\cos\left(\frac{\pi y}{L_y}\right)=1$
  (the bulging effect is the largest)

  when $x=\frac{L_x}{2}$ or $y=\frac{L_y}{2}$ (in edge), $\cos\left(\frac{\pi x}{L_x}\right)=0$ or $\cos\left(\frac{\pi y}{L_y}\right)=0$
  (the bulging effect is 0)