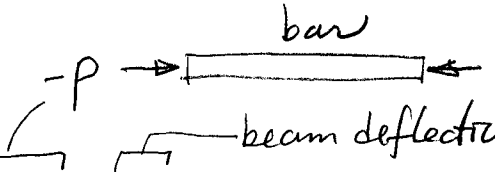
8.7 Application II – plate bending & buckling

We have discussed beam buckling via



$$U_{beam} = \frac{1}{2}\int EA\,\bar{u}_x^2\,dx + \frac{1}{2}\int EI\,v_{xx}^2\,dx + \frac{1}{2}\int (EA\,\bar{u}_x)\,v_x^2\,dx \qquad (8.7.1)$$

axial bar eq. | beam bending Eq. | coupling between bar and beam

For a plate, we have the following model equation:

$$U_{plate} = \frac{1}{2}\int D\{\underbrace{w_{xx}^2 + w_{yy}^2 + 2\nu w_{xx}w_{yy} + 2(1-\nu)w_{xy}^2}_{\text{plate bending}}\}\,dx\,dy$$

$$+ \frac{1}{2}\int [\underbrace{N_x w_x^2 + N_y w_y^2 + 2N_{xy} w_x w_y}_{\text{plate axial + bending coupling}}]\,dx\,dy$$

$$+ \frac{1}{2}\int \{\underbrace{\frac{Eh}{1-\nu^2}(\bar{u}_x + \bar{v}_y)^2 + Gh[(\bar{u}_y + \bar{v}_x)^2 - 4\bar{u}_x\bar{v}_y]}_{\text{two dimensional plane stress model}}\}\,dx\,dy \qquad (8.7.2)$$

$$\begin{Bmatrix} N_x \\ N_y \\ N_{xy} \end{Bmatrix} = \int_{-\frac{h}{2}}^{\frac{h}{2}} \begin{Bmatrix} \sigma_{xx} \\ \sigma_{yy} \\ \sigma_{xy} \end{Bmatrix} dz$$