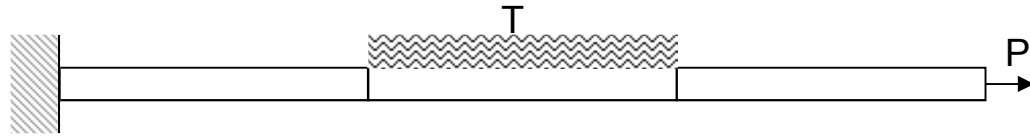
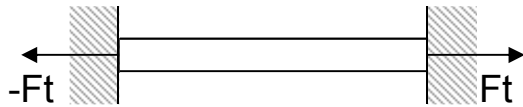


Carga Térmica

Análisis



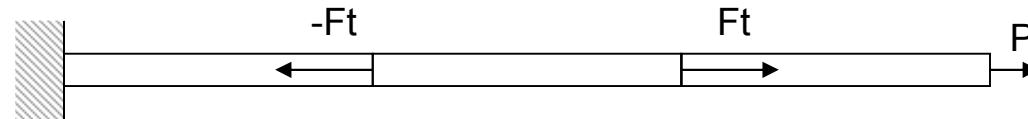
1) Elemento completamente restringido



$$F_t = \alpha A E \Delta T$$

$$\sigma_0 = -\alpha E \Delta T$$

2) Armar estructura



3) Resolver

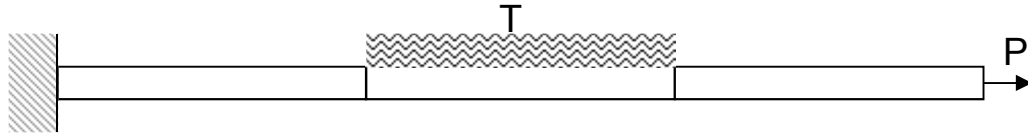
$$\frac{AE}{L} \begin{bmatrix} 1 & -1 & 0 & 0 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 2 & -1 \\ 0 & 0 & -1 & 1 \end{bmatrix} \begin{Bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \end{Bmatrix} = \begin{Bmatrix} F_1 \\ -F_t \\ F_t \\ P \end{Bmatrix} \quad ; \quad \{D\} = \begin{Bmatrix} u_1 \\ u_2 \\ u_3 \\ u_4 \end{Bmatrix} \quad \sigma = E \varepsilon = E B D$$

4) Superponer tensiones

$$\sigma = E \varepsilon + \sigma_0$$

Carga Térmica

Resolución



Planteo de sistema

$$\frac{AE}{L} \begin{bmatrix} 1 & -1 & 0 & 0 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 2 & -1 \\ 0 & 0 & -1 & 1 \end{bmatrix} \begin{Bmatrix} 0 \\ u_2 \\ u_3 \\ u_4 \end{Bmatrix} = \begin{Bmatrix} R \\ -F_t \\ F_t \\ P \end{Bmatrix}$$

Aplicación Restricciones

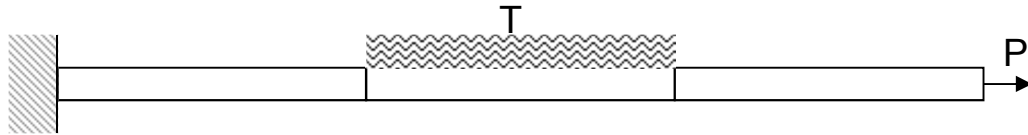
$$\frac{AE}{L} \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 1 \end{bmatrix} \begin{Bmatrix} u_2 \\ u_3 \\ u_4 \end{Bmatrix} = \begin{Bmatrix} -\alpha AE \Delta T \\ \alpha AE \Delta T \\ P \end{Bmatrix}$$

Resolución

$$\begin{Bmatrix} u_2 \\ u_3 \\ u_4 \end{Bmatrix} = \begin{Bmatrix} \frac{LP}{AE} \\ L\alpha\Delta T + \frac{2LP}{AE} \\ L\alpha\Delta T + \frac{3LP}{AE} \end{Bmatrix}$$

Carga Térmica

Resolución



Paso a Tensiones

$$\sigma = E B D + \sigma_0$$

$$B = \begin{bmatrix} -\frac{1}{L} & \frac{1}{L} \end{bmatrix}$$

$$\sigma_1 = E \begin{bmatrix} -\frac{1}{L} & \frac{1}{L} \end{bmatrix} \left\{ 0 \quad \frac{LP}{AE} \right\} = \frac{P}{A}$$

$$\sigma_2 = E \begin{bmatrix} -\frac{1}{L} & \frac{1}{L} \end{bmatrix} \left\{ \frac{LP}{AE} \quad L\alpha\Delta T + \frac{2LP}{AE} \right\} = -\frac{P}{A} + E\alpha\Delta T + \frac{2P}{A} = E\alpha\Delta T + \frac{P}{A}$$

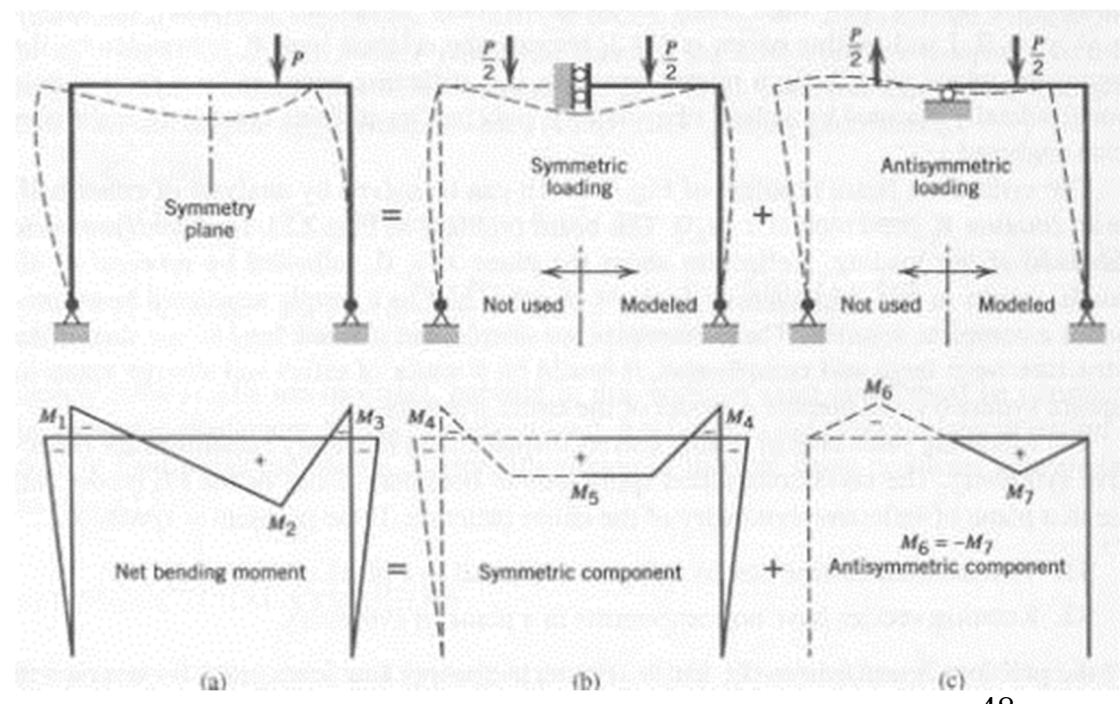
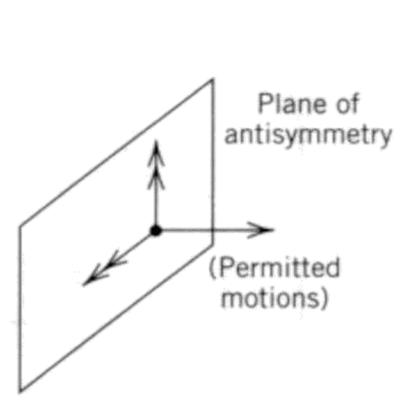
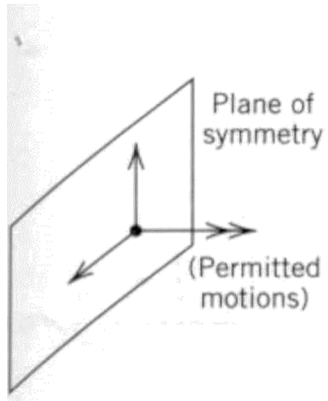
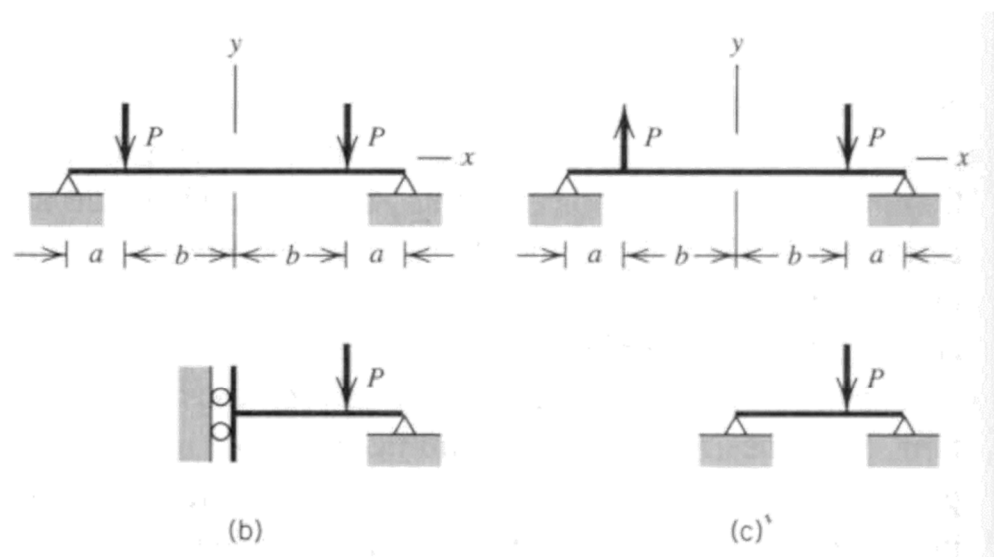
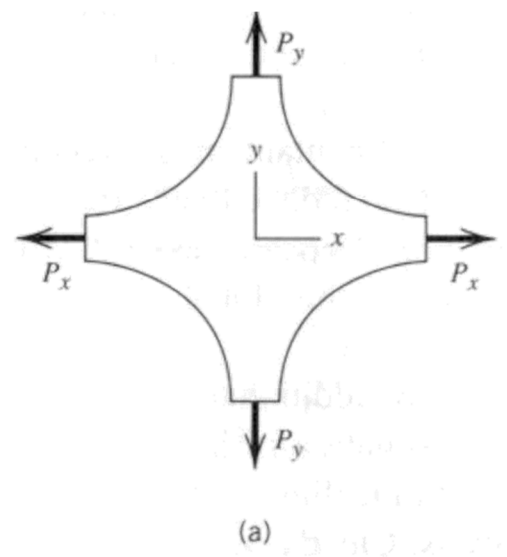
$$\sigma_3 = E \begin{bmatrix} -\frac{1}{L} & \frac{1}{L} \end{bmatrix} \left\{ L\alpha\Delta T + \frac{2LP}{AE} \quad L\alpha\Delta T + \frac{3LP}{AE} \right\} = \frac{P}{A}$$

Resultado:

Compensación de tensión térmica
con tensión estructura.

$$\sigma = \sigma_2 + \sigma_0 = \frac{P}{A}$$

Simetrías



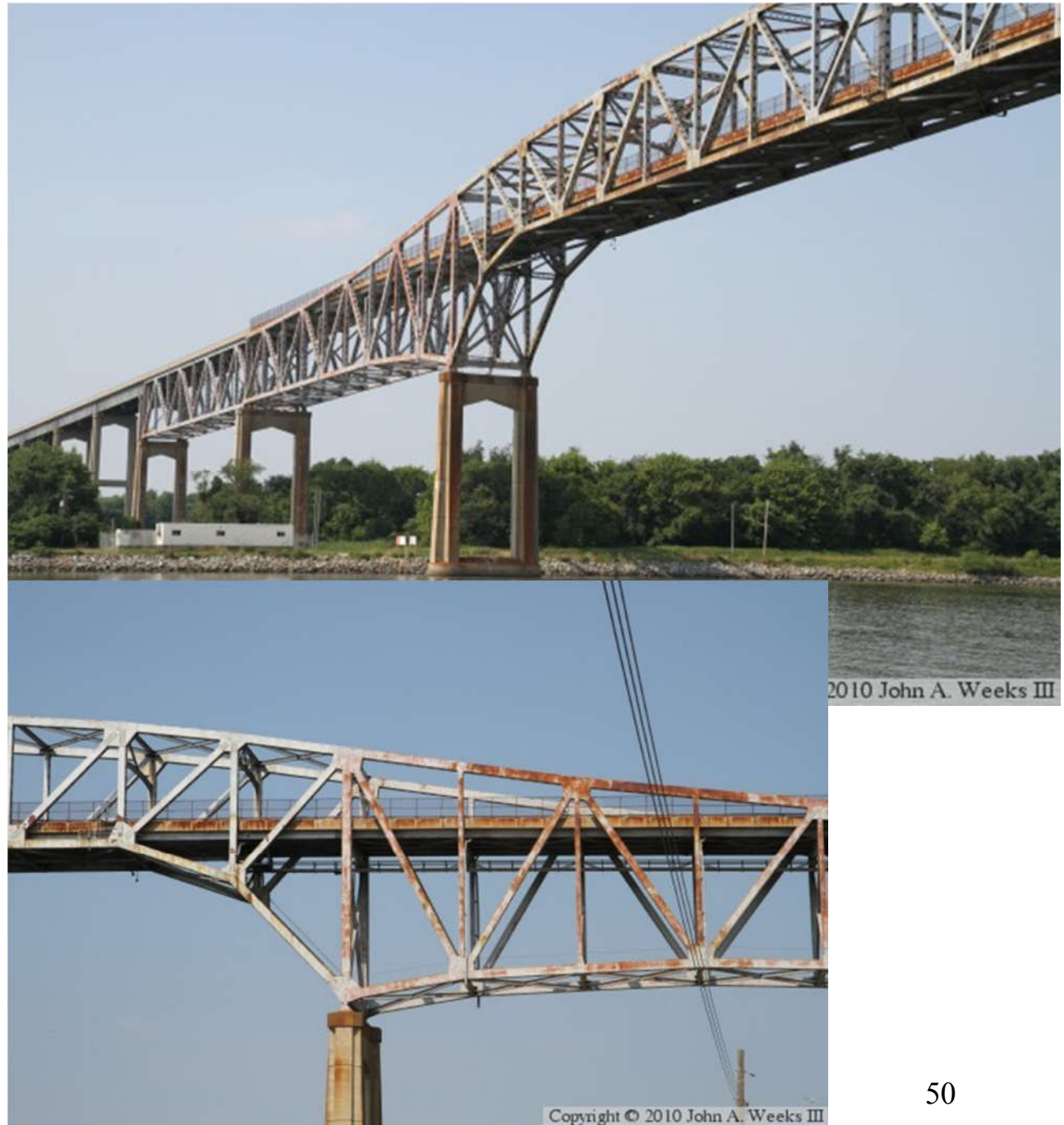
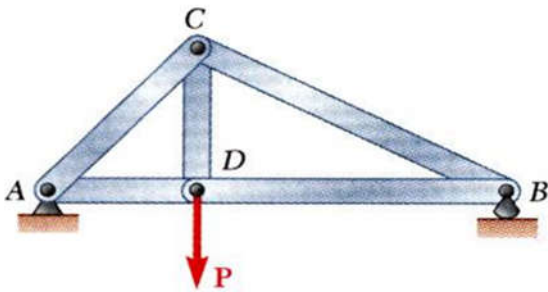
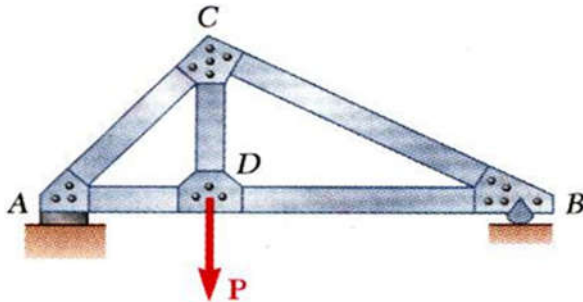
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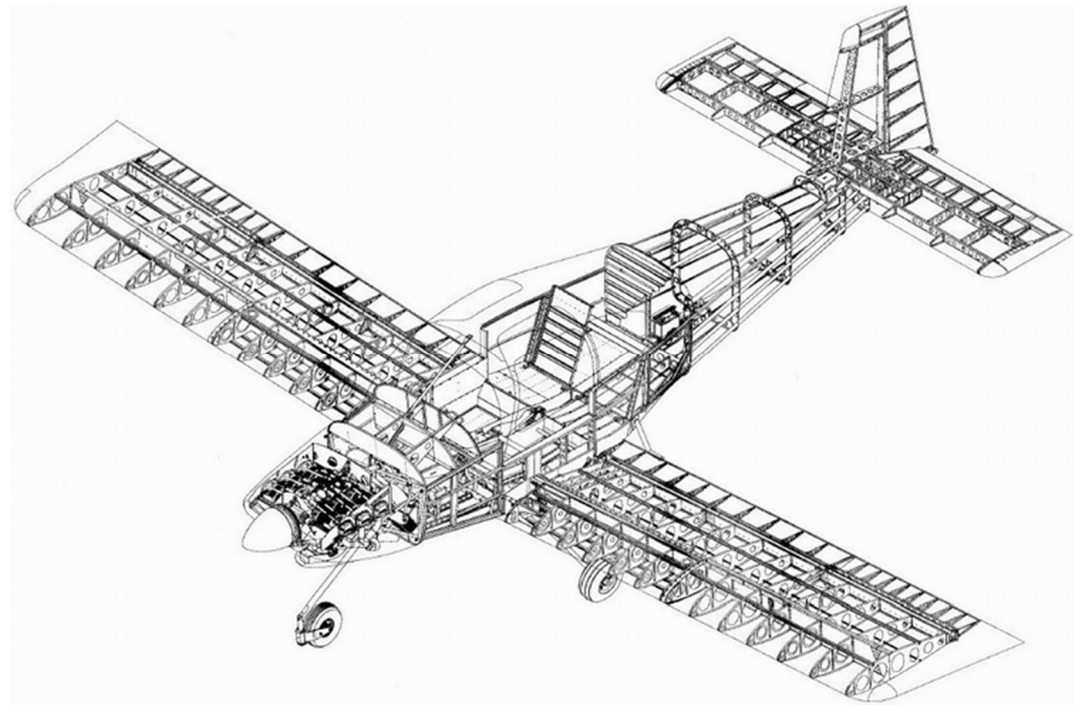
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Mecanismos

