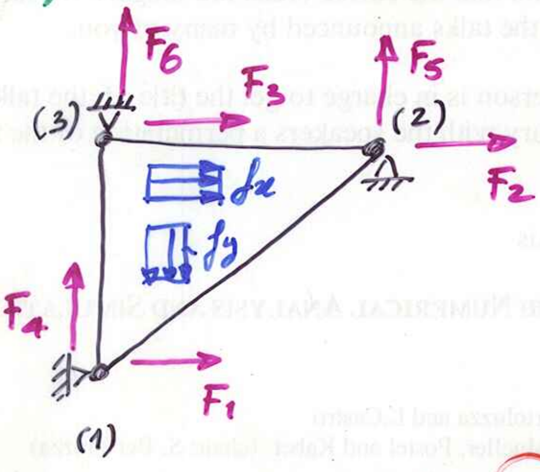
VECTOR DAS FORÇAS NODAIS EQUIVALENTES

- **FORÇAS DE MASSA.**



$$\underline{F} = \int_V \underline{\Psi}\, \underline{f}\, dV = \int_V \overbrace{\begin{bmatrix} \psi_1 & 0 \\ \psi_2 & 0 \\ \psi_3 & 0 \\ \hline 0 & \psi_1 \\ 0 & \psi_2 \\ 0 & \psi_3 \end{bmatrix}}^{\Psi^T} \overbrace{\begin{bmatrix} f_x \\ f_y \end{bmatrix}}^{\underline{f}} dV$$

$$\underline{F} = \int_V \begin{bmatrix} \psi_1(x,y)\, f_x(x,y) \\ \psi_2(x,y)\, f_x(x,y) \\ \psi_3(x,y)\, f_x(x,y) \\ \hline \psi_1(x,y)\, f_y(x,y) \\ \psi_2(x,y)\, f_y(x,y) \\ \psi_3(x,y)\, f_y(x,y) \end{bmatrix} dV$$

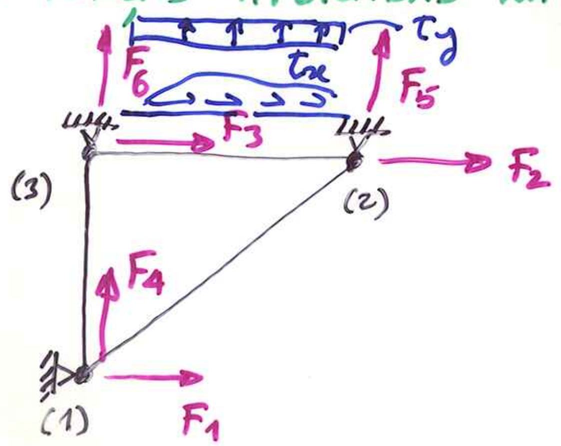
CASO PARTICULAR

+ FORÇAS DE MASSA CONSTANTES

$$\underline{F} = \frac{1}{3} \begin{bmatrix} A f_x \\ A f_x \\ A f_x \\ \hline A f_y \\ A f_y \\ A f_y \end{bmatrix} \qquad A = \text{área do elemento}$$

VECTOR DAS FORÇAS NODAIS EQUIVALENTES

- FORÇAS APLICADAS NA FRONTEIRA.

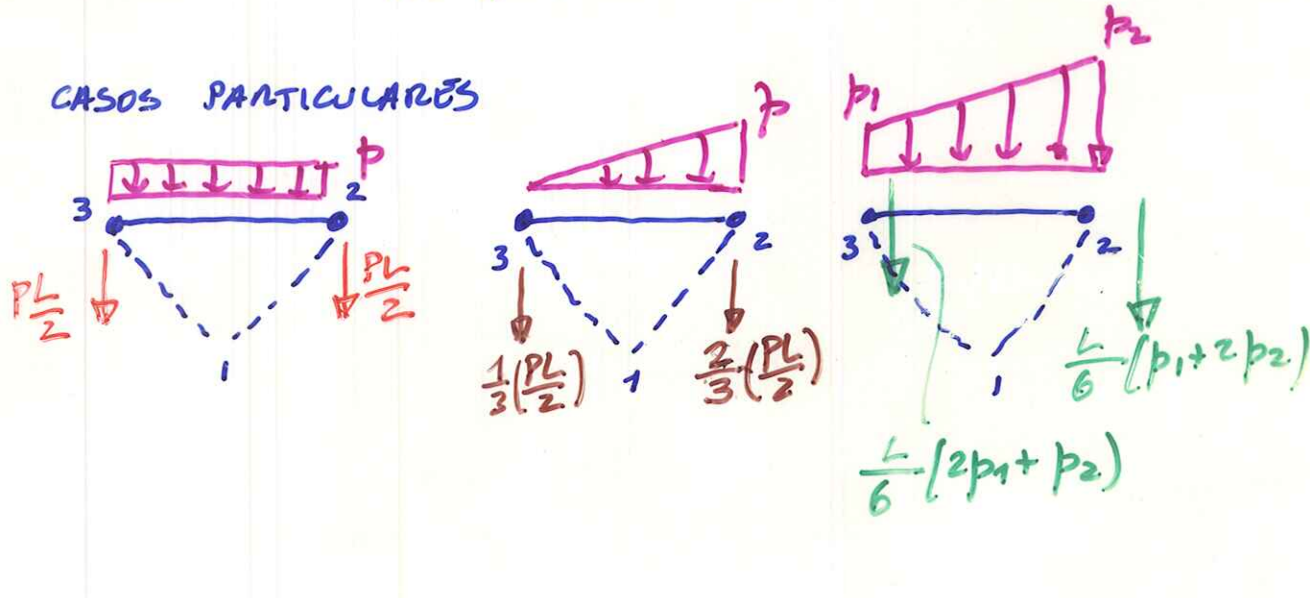


$$\underline{F} = \int_{\Gamma} \underline{\bar{\Psi}}\,\underline{t}\,d\Gamma = \int_{\Gamma} \begin{bmatrix} \bar{\Psi}_1 & 0 \\ \bar{\Psi}_2 & 0 \\ \bar{\Psi}_3 & 0 \\ \hline 0 & \bar{\Psi}_1 \\ 0 & \bar{\Psi}_2 \\ 0 & \bar{\Psi}_3 \end{bmatrix} \begin{bmatrix} t_x \\ t_y \end{bmatrix} d\Gamma$$

INTEGRAÇÃO AO LONGO DO LADO CARREGADO

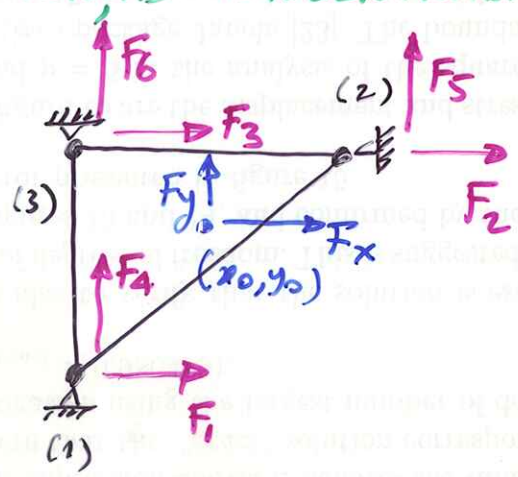
$$\underline{F} = \int_{\Gamma} \begin{bmatrix} \bar{\Psi}_1(x,y)\,t_x \\ \bar{\Psi}_2(x,y)\,t_x \\ \bar{\Psi}_3(x,y)\,t_x \\ \hline \bar{\Psi}_1(x,y)\,t_y \\ \bar{\Psi}_2(x,y)\,t_y \\ \bar{\Psi}_3(x,y)\,t_y \end{bmatrix} d\Gamma$$

CASOS PARTICULARES



VECTOR DAS FORÇAS NODAIS EQUIVALENTES

• FORÇAS CONCENTRADAS •



$$\underline{F} = \begin{bmatrix} F_x\ \psi_1(x_0,y_0) \\ F_x\ \psi_2(x_0,y_0) \\ F_x\ \psi_3(x_0,y_0) \\ \hline F_y\ \psi_1(x_0,y_0) \\ F_y\ \psi_2(x_0,y_0) \\ F_y\ \psi_3(x_0,y_0) \end{bmatrix}$$