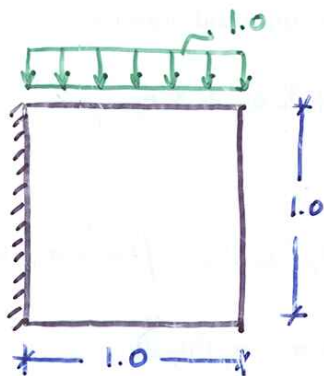
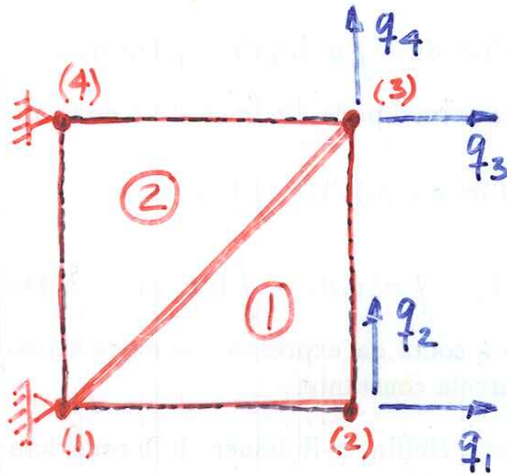


# ANÁLISE DA CONSOLA

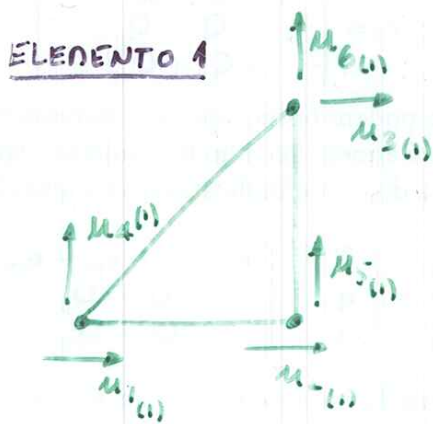


$E = 1.0$   
 $\nu = 0.3$

## DISCRETIZAÇÃO DA ESTRUTURA (1)



## APROXIMAÇÃO DOS DESLOCAMENTOS EM CADA ELEMENTO (2)

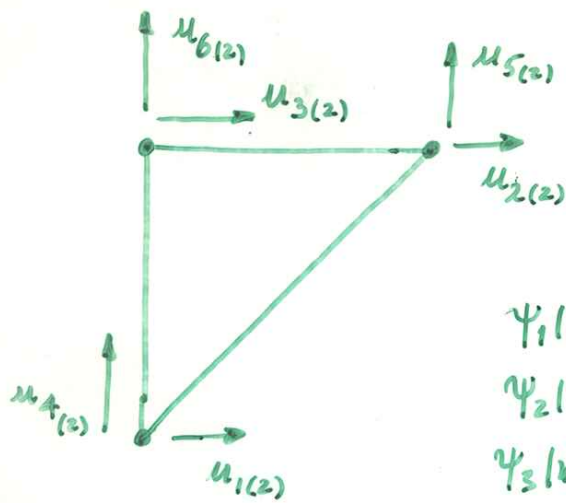


Local	1	2	3	4	5	7
Global	X	1	3	X	2	4

$\psi_1(x,y) = 1-x$   
 $\psi_2(x,y) = x-y$   
 $\psi_3(x,y) = y$

$$\begin{bmatrix} u_x(x,y) \\ u_y(x,y) \end{bmatrix} = \begin{bmatrix} (1-x) & (x-y) & (y) & | & 0 & 0 & 0 \\ 0 & 0 & 0 & | & (1-x) & (x-y) & (y) \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ \hline u_4 \\ u_5 \\ u_7 \end{bmatrix}$$

## ELEMENTO 2



local	1	2	3	4	5	6
global	X	3	X	X	4	X

$$\psi_1(x,y) = 1-y$$

$$\psi_2(x,y) = x$$

$$\psi_3(x,y) = y-x$$

$$\begin{bmatrix} u_x(x,y) \\ u_y(x,y) \end{bmatrix}_{(2)} = \begin{bmatrix} (1-y) & (x) & (y-x) & | & 0 & 0 & 0 \\ 0 & 0 & 0 & | & (1-y) & (x) & (y-x) \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \\ u_3 \\ \hline u_4 \\ u_5 \\ u_6 \end{bmatrix}_{(2)}$$

### • OBTENÇÃO DAS EQUAÇÕES ELEMENTARES (3)

#### ELEMENTO 1

$$K^{(1)} = [(6 \times 6)] \sim (\text{geometria} + \text{propriedades elásticas})$$

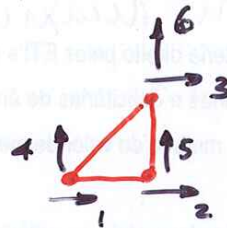
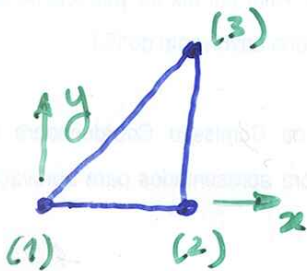
$$F^{(1)} = [(6)] \sim (\text{forças de massa} \\ \text{tempos aplicadas na fronteira})$$

#### ELEMENTO 2

$$K^{(2)} = [(6 \times 6)]$$

$$F^{(2)} = [(6)]$$

# ELEMENTO 1



## • MATRIZ DE RIGIDEZ ELEMENTAR

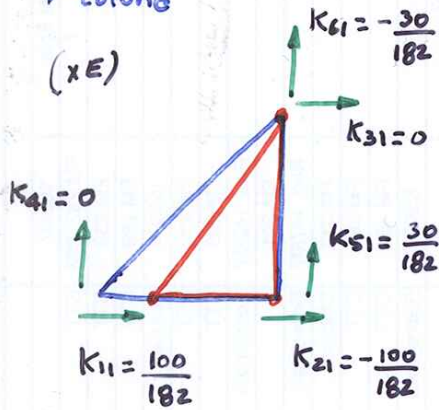
$$\underline{\underline{K}}^{(1)} = \begin{bmatrix} \frac{100}{182} & -\frac{100}{182} & 0 & 0 & \frac{30}{182} & -\frac{30}{182} \\ & \frac{135}{182} & -\frac{5}{26} & \frac{5}{26} & -\frac{5}{14} & \frac{30}{182} \\ & & \frac{5}{26} & -\frac{5}{26} & \frac{5}{26} & 0 \\ & & & \frac{5}{26} & -\frac{5}{26} & 0 \\ & \text{Simétrico} & & & \frac{135}{182} & -\frac{100}{182} \\ & & & & & \frac{100}{182} \end{bmatrix} E$$

## • VECTOR DAS FORÇAS NODAIS EQUIVALENTES

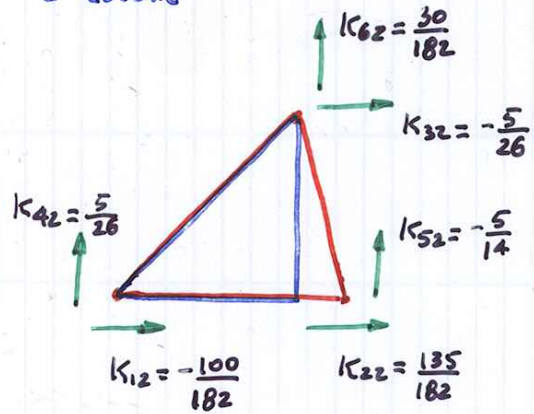
$$\underline{\underline{F}}^{(1)} = \begin{bmatrix} 0.0 \\ 0.0 \\ 0.0 \\ \hline 0.0 \\ 0.0 \\ 0.0 \end{bmatrix}$$

• MATRIZ DE RIGIDEZ ELEMENTAR - ELEMENTO 1

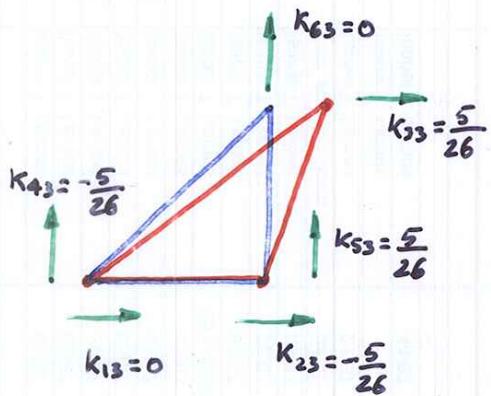
1ª columna



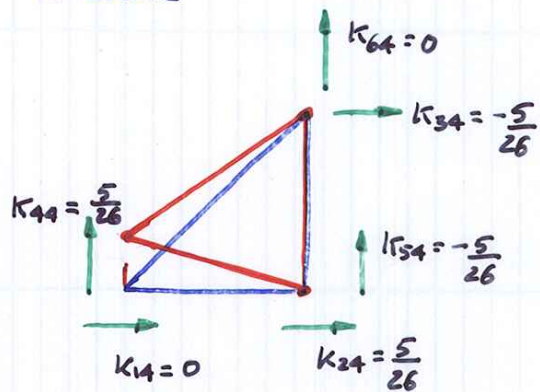
2ª columna



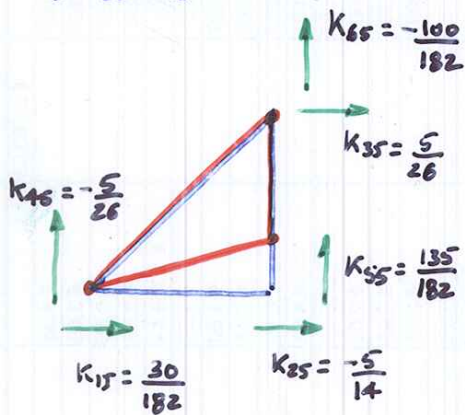
3ª columna



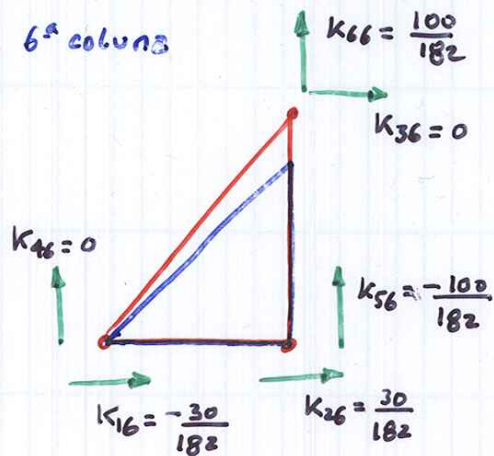
4ª columna



5ª columna

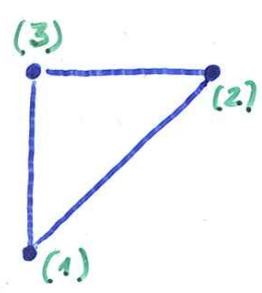


6ª columna

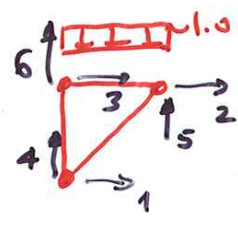




# ELEMENTO 2



$$\begin{aligned} \Psi_1(x) &= 1-y \\ \Psi_2(x) &= y-x \\ \Psi_3(x) &= x \end{aligned}$$



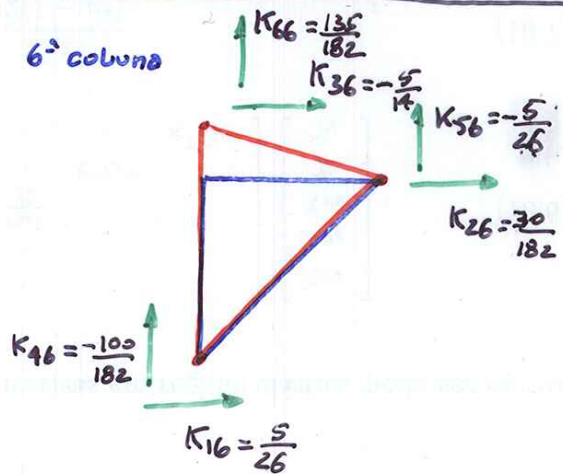
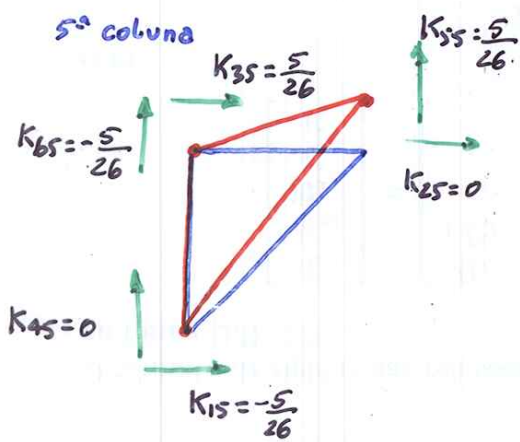
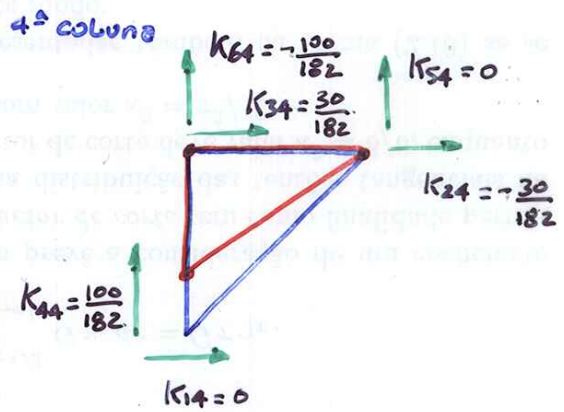
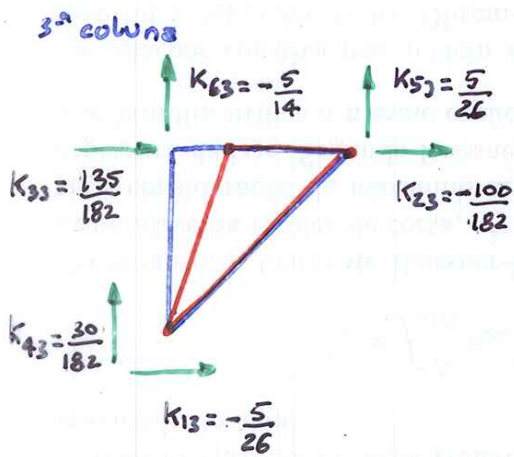
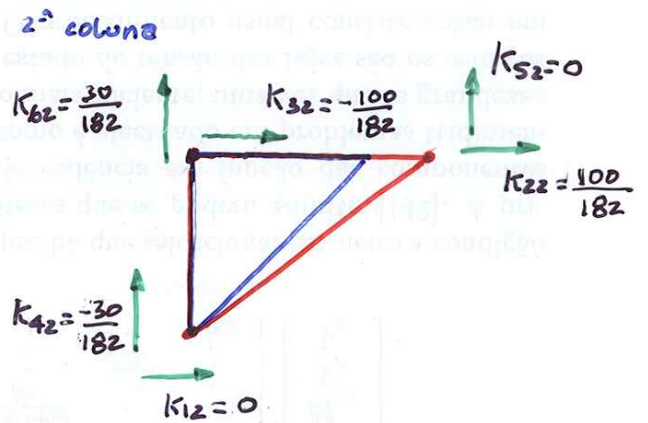
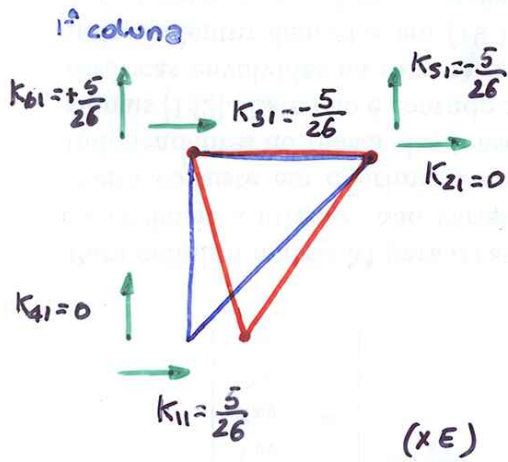
## • MATRIZ DE RIGIDEZ ELEMENTAR

$$K^{(2)} = \begin{bmatrix} 5/26 & 0 & -5/26 & 0 & -5/26 & 5/26 \\ & 100/182 & -100/182 & -30/182 & 0 & 30/182 \\ & & 135/182 & 30/182 & 5/26 & -5/14 \\ & & & 100/182 & 0 & -100/182 \\ \text{Simétrico} & & & & 5/26 & -5/26 \\ & & & & & 135/182 \end{bmatrix}$$

## • VETOR DAS FORÇAS NODAIS EQUIVALENTES

$$F^{(2)} = \begin{bmatrix} 0.0 \\ 0.0 \\ 0.0 \\ \hline 0.0 \\ -0.5 \\ -0.5 \end{bmatrix}$$

• MATRIZ DE RIGIDEZ ELEMENTAR - ELEMENTO 2



• OBTENÇÃO DA EQUAÇÃO DE EQUILÍBRIO GLOBAL (4)

①

1	2	3	4	5	6
X	1	3	X	2	4

②

1	2	3	4	5	6
X	3	X	X	4	X

(MATRIZ DE RIGIDEZ)

$$K_{11} = K_{22}^{(1)}$$

$$K_{22} = K_{55}^{(1)}$$

$$K_{33} = K_{33}^{(1)} + K_{22}^{(2)} \quad K_{44} = K_{66}^{(1)} + K_{55}^{(2)}$$

$$K_{12} = K_{25}^{(1)}$$

$$K_{23} = K_{53}^{(1)}$$

$$K_{34} = K_{36}^{(1)} + K_{25}^{(2)}$$

$$K_{13} = K_{23}^{(1)}$$

$$K_{24} = K_{56}^{(1)}$$

$$K_{14} = K_{26}^{(1)}$$

$$\underline{K}_* = \frac{E}{182} \begin{bmatrix} 135 & -65 & -35 & 30 \\ -65 & 135 & 35 & -100 \\ -35 & 35 & 135 & 0 \\ 30 & -100 & 0 & 135 \end{bmatrix}$$

(FORÇAS NODAIS)

$$F_1 = F_2^{(1)}$$

$$F_2 = F_5^{(1)}$$

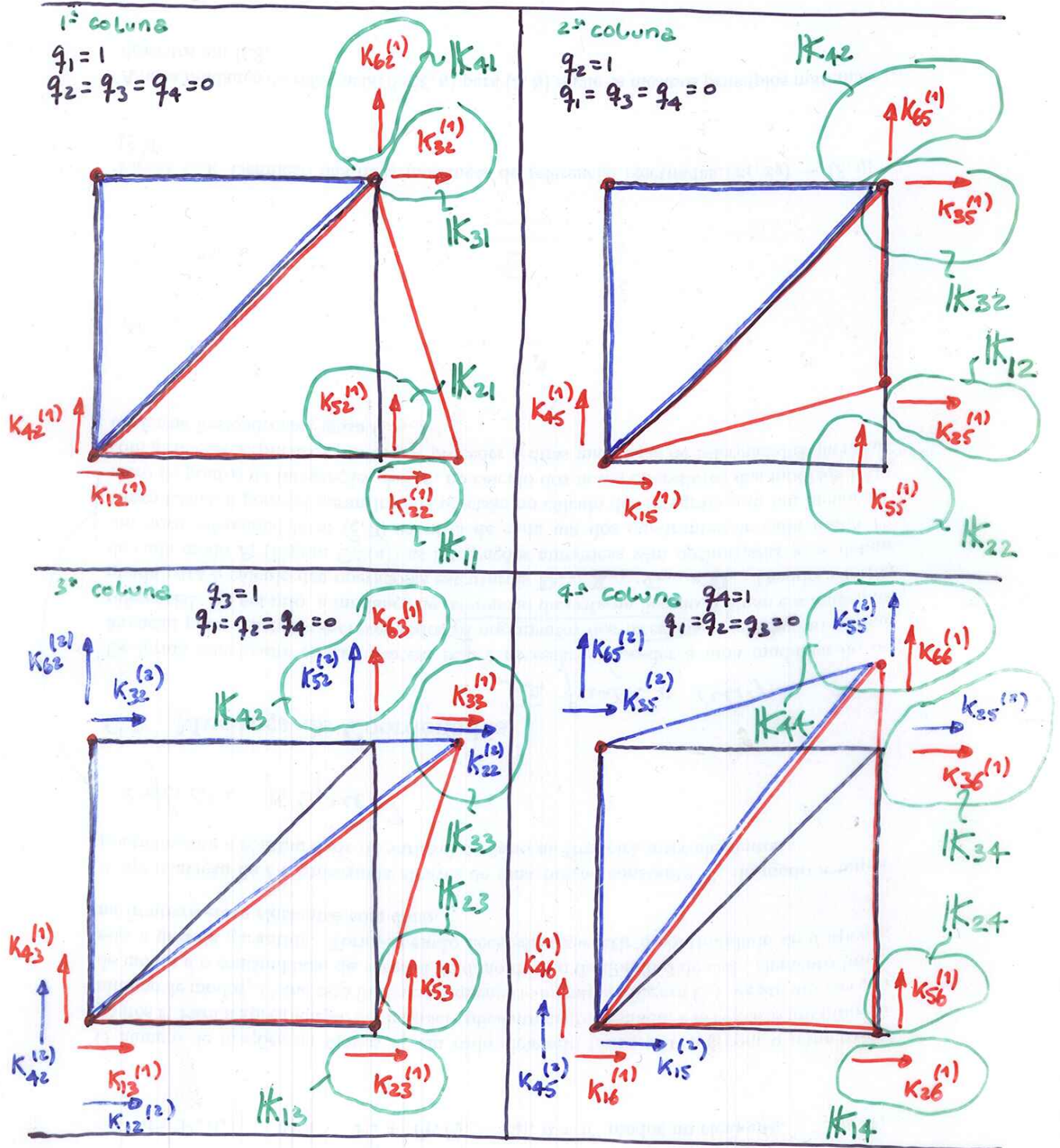
$$F_3 = F_3^{(1)} + F_2^{(2)}$$

$$F_4 = F_6^{(1)} + F_5^{(2)}$$

$$\underline{F}_* = \begin{bmatrix} 0 \\ 0 \\ 0 \\ -0.5 \end{bmatrix}$$



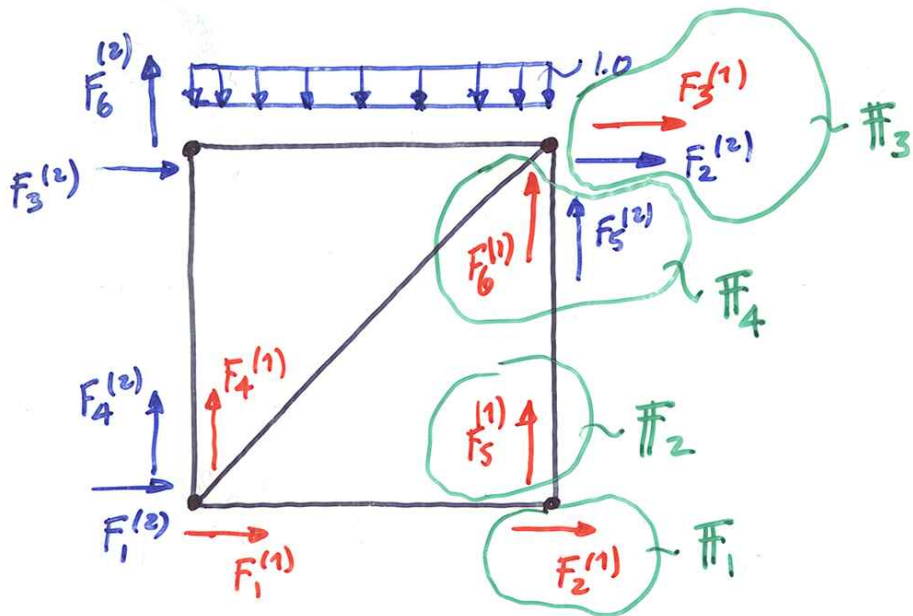
MATRIZ DE RIGIDEZ GLOBAL (SOL. COMPLEMENTAR)





• VECTOR DAS FORÇAS NODAIS APLICADAS (SOL. PARTICULAR.)

$q_1 = q_2 = q_3 = q_4 = 0$  + CARREGAMENTO



• RESOLUÇÃO DA EQUAÇÃO DE EQUILÍBRIO (5)

$$\underline{K}_x q = \underline{F}_x \Rightarrow \begin{bmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \end{bmatrix} = \frac{1}{E} \begin{bmatrix} -0.2423 \\ -1.4575 \\ 0.3150 \\ -1.6999 \end{bmatrix}$$

• TRATAMENTO DA SOLUÇÃO (6)

PÓS-PROCESSAMENTO

[ANÁLISE CRÍTICA DOS RESULTADOS OBTIDOS]

