b) Assembling of the stiffness matrix $\hat{K}_h = [\hat{K}_{ij}]_{i,j\in\bar{\omega}_h}$

- **Starting point:** $\forall i,j \in \omega_h$

$$K_{ij} = a(p^{(j)},p^{(i)}) = \begin{cases} 0\,, & \text{if } B_{ij} = B_i \cap B_j = \emptyset \\ \sum\limits_{r\in B_{ij}} \Big(\int\limits_{\delta_r} (\lambda \nabla^T p^{(j)} \nabla p^{(i)} + a p^{(j)} p^{(i)})dx + \underbrace{\int\limits_{\Gamma_3\cap\partial\delta_r} \varkappa p^{(j)} p^{(i)} ds_x}_{\text{3rd Kind BC}} \Big) \end{cases}$$

model problem from Subsection 2.2.1

3rd Kind BC $\longrightarrow$ c)

- **FE technology for elementwise computing the contributions to $\hat{K}_{ij}$:**

$$\hat{K}_{ij} = \sum_{r\in B_{ij}} \int\limits_{\delta_r} (\lambda \nabla^T p^{(j)} \nabla p^{(i)} + a\, p^{(j)} p^{(i)})dx \Rightarrow \hat{K}_h = [\hat{K}_{ij}]_{i,j\in\bar{\omega}_h}$$

$\forall i,j \in \bar{\omega}_h = \omega_h \cup \gamma_h$: $B_{ij} := B_i \cap B_j \neq \emptyset$

NOT componentwise, BUT elementwise !!

Example: $i=8$, $j=9 \Rightarrow B_{ij} = \{8,9,18,19,20\} \cap \{9,10,20\} = \{9,20\}$

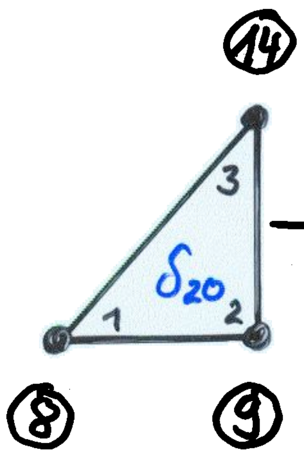
$\Gamma_3 \cap$, $\Gamma_3 \cap \partial\delta_{20} = \emptyset$

$$\hat{K}_{8,9} = \int\limits_{\delta_9} (\ \ldots\ )\,dx + \int\limits_{\delta_{20}} (\ \ldots\ )\,dx$$

Loop over all elements: $r = 1,\ldots,8,9,10,\ldots,19,\boxed{20},21,\ldots,24$

$\boxed{r: \alpha \leftrightarrow i}$

1	2	3
8	9	14



element stiffness matrix $\rightarrow$ $K^{(20)} = \begin{bmatrix} K_{11} & K_{12} & K_{13} \\ K_{21} & K_{22} & K_{23} \\ K_{31} & K_{32} & K_{33} \end{bmatrix}_{3\times 3}$ $\oplus$ $\begin{bmatrix} \hat{K}_{11} & & \\ & \hat{K}_{88} & \hat{K}_{89} \\ & & \end{bmatrix}_{N_h \times N_h}$

Assembling $\hat{K}_h$