

Appendix A1.

The way of determining the stiffness coefficients of SDEs of a rectangular plate of dimensions $L \times B$, divided into a finite number of fragments of dimensions $\Delta l \times \Delta b$ (Fig. A1.1) [37] is presented in Table A1.1.

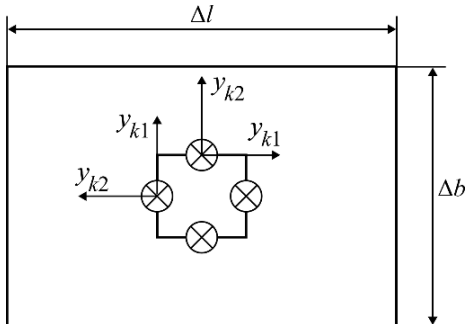


Fig. A1.1. Discrete fragment of a rectangular plate containing 4 SDEs

Table A1.1. Stiffness coefficients in local coordinate systems of SDE

Coordinate system configuration		
Tension/compression	$k_1 = \frac{Eh\Delta b}{2\Delta l}$	$k_1 = \frac{Eh\Delta l}{2\Delta b}$
Shear	$k_2 = k_3 = \frac{Gh\Delta b}{2\kappa\Delta l}$	$k_2 = k_3 = \frac{Gh\Delta l}{2\kappa\Delta b}$
Torsion	$k_4 = \frac{Gh^3\Delta b}{2 \cdot 6 \cdot \Delta l}$	$k_4 = \frac{Gh^3\Delta l}{2 \cdot 6 \cdot \Delta b}$
Bending	$k_5 = \frac{Eh^3\Delta b}{2 \cdot 12(1 - \nu^2) \cdot \Delta l}$	$k_5 = \frac{Eh^3\Delta l}{2 \cdot 12(1 - \nu^2) \cdot \Delta b}$
Torsion in the plate plane	$k_6 = \frac{GJ_s}{4h}$, where: $J_s = K_1 \cdot (\min(\Delta l, \Delta b))^3 \cdot \max(\Delta l, \Delta b)$. $K_1 = \frac{1}{3} - \frac{64 \cdot \min(\Delta l, \Delta b)}{\pi^5 \cdot \max(\Delta l, \Delta b)} \sum_{n=0}^{\infty} \frac{tgh\left(\frac{(2n+1)\pi \cdot \max(\Delta l, \Delta b)}{2 \cdot \min(\Delta l, \Delta b)}\right)}{(2n+1)^5}$	

Notation:

E – Young modulus. G – Kirchoff modulus. ν – Poisson ratio.

κ – cross-section shape coefficient (for rectangle. $\kappa = 1.2$). h – plate thickness.

Appendix A2.

By dividing a rectangular plate of dimensions $L \times B$ into a finite number of fragments of dimensions $\Delta l \times \Delta b$, 4 types of RFEs are obtained (Fig. A2.1). The way for determining their inertia coefficients is presented in Table A2.1 [37].

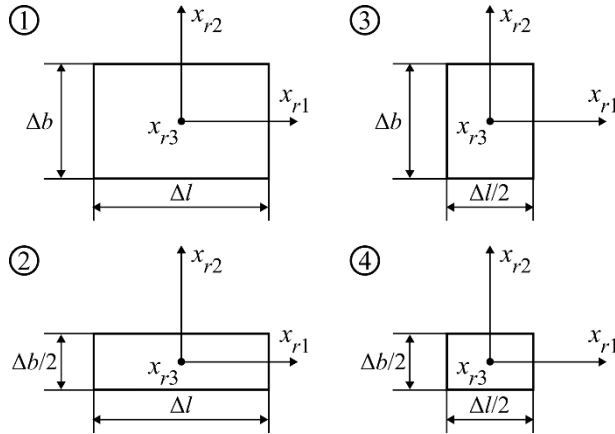


Fig. A2.1. Types of RFEs due to a subdivision of a rectangular plate

Table A2.1. Inertia coefficients in local coordinate systems of various RFEs

r	m_{r3}	m_{r4}	m_{r5}
1	$\rho \Delta l \Delta b h$	$\frac{m_{r3}}{12} \Delta b^2$	$\frac{m_{r3}}{12} \Delta l^2$
2	$\frac{1}{2} \rho \Delta l \Delta b h$	$\frac{m_{r3}}{12} \left(\frac{\Delta b}{2}\right)^2$	$\frac{m_{r3}}{12} \Delta l^2$
3	$\frac{1}{2} \rho \Delta l \Delta b h$	$\frac{m_{r3}}{12} \Delta b^2$	$\frac{m_{r3}}{12} \left(\frac{\Delta l}{2}\right)^2$
4	$\frac{1}{4} \rho \Delta l \Delta b h$	$\frac{m_{r3}}{12} \left(\frac{\Delta b}{2}\right)^2$	$\frac{m_{r3}}{12} \left(\frac{\Delta l}{2}\right)^2$

Notation:

r – type of RFE. ρ – mass density of RFE, m_{r3} – mass of r -type RFE.

m_{r4} – mass moment of inertia of r -type RFE about the x_{r1} axis.

m_{r5} – mass moment of inertia of r -type RFE about the x_{r2} axis.

Appendix A3.

1. Matrix of gyroscopic effects of E-BB no. e , described in the Cartesian coordinate system x_{e1} , x_{e2} , x_{e3} , has the form [7]:

$$\hat{\mathbf{L}}_e = \int_{(m)} \mathbf{N}_e^T \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -\omega \\ 0 & \omega & 0 \end{bmatrix} \mathbf{N}_e dm = \rho A \int_0^{l_e} \mathbf{N}_e^T \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & -\omega \\ 0 & \omega & 0 \end{bmatrix} \mathbf{N}_e dx_{e1} \quad (\text{A3.1})$$

where: \mathbf{N}_e – matrix of shape functions of E-BB no. e [7]. m – mass of E-BB no. e . ρ – mass density of E-BB no. e . A – cross-section area of E-BB no. e . l_e – length of E-BB no. e . ω – angular velocity about the x_{e1} axis of E-BB no. e .

2. Matrix dependent on the square of the angular velocities of E-BB no. e , described in the Cartesian coordinate system x_{e1} , x_{e2} , x_{e3} , has the form [7]:

$$\hat{\mathbf{K}}_e = \int_{(m)} \mathbf{N}_e^T \begin{bmatrix} 0 & 0 & 0 \\ 0 & \omega^2 & 0 \\ 0 & 0 & \omega^2 \end{bmatrix} \mathbf{N}_e dm = \rho A \int_0^{l_e} \mathbf{N}_e^T \begin{bmatrix} 0 & 0 & 0 \\ 0 & \omega^2 & 0 \\ 0 & 0 & \omega^2 \end{bmatrix} \mathbf{N}_e dx_{e1}. \quad (\text{A3.2})$$