

$$\begin{aligned}
2\langle \mathcal{P}(\mathcal{A} + \mathcal{L}_{\mathcal{G}})e, e \rangle &= 2\beta \int_0^1 e^T P \frac{d^2}{dx^2} e + 2\alpha \int_0^1 e^T P e \\
&+ 2 \int_0^1 e^T P G L e = 2\beta e^T P \frac{d}{dx} e \Big|_0^1 - 2\beta \int_0^1 \frac{d}{dx} e^T P \frac{d}{dx} e \\
&+ 2\alpha \int_0^1 e^T P e + 2 \int_0^1 e^T P G L e \\
&= -2\beta e^T(0) P \bar{K} \int_0^1 e - 2\beta \int_0^1 \frac{d}{dx} e^T P \frac{d}{dx} e \\
&+ 2\alpha \int_0^1 e^T P e + 2 \int_0^1 e^T P G L e
\end{aligned}$$