Step-1

Let $A^{-1}b = x$ and further suppose that x satisfies $Cx = d$.

Thus, we get

$$\begin{aligned} P_{C/\min} &= P_{\min} + \frac{1}{2} y^{\mathrm{T}} \left(CA^{-1}b - d \right) \\ &= P_{\min} + \frac{1}{2} y^{\mathrm{T}} \left(Cx - d \right) \\ &= P_{\min} + \frac{1}{2} y^{\mathrm{T}} \left(0 \right) \\ &= P_{\min} \end{aligned}$$

Step-2

Thus, whenever $A^{-1}b = x$ satisfies $Cx = d$, we get $\boxed{P_{C/\min} = P_{\min}}$.