$= 2ab\,{}^t x Q x' \quad = 2ab\,{}^t x Q Q^{-1} Q' x = 2ab\,{}^t x Q' x$
$= 0$ since $x \in F$. Note that x & x' are not linearly independent, i.e. $x \neq x'$, for otherwise
$x = x' = Q^{-1} Q' x \Rightarrow Q x = Q' x \Rightarrow T_x G = T_x F$
which is impossible since G meets F transversely.
Thus $x'' = ax + bx'$, otherwise $x = x'$, since $a_1 x'' + a_2 x + a_2 x' = 0 \Rightarrow$ if $a_1 = 0$, $x_1 = x'$.

③ $x' \in F$

$(Q'x', x') = 0$?

Since $\deg F = 2$, $\#(L \cdot F) = 2$. $\Rightarrow \exists\ y \in L$ s.t $y \in F$.
$\Rightarrow y = ax + bx'$ for some $a, b \in \mathbb{C}$
$\Rightarrow (Q'y, y) = {}^t y Q' y = (a\,{}^t x + b\,{}^t x') Q' (ax + bx')$
$= a^2\,{}^t x Q' x + ab\,{}^t x' Q' x + ab\,{}^t x Q' x' + b^2\,{}^t x' Q' x' = 0$
$= 2ab\,{}^t x Q' x' + b^2\,{}^t x' Q' x' = b^2\,{}^t x' Q' x'$ since
${}^t x Q' x' = x Q' Q^{-1} Q' x = 0$ ($\because x \in H$).
$\Rightarrow$ In case $b \neq 0$, ${}^t x' Q' x' = 0 \Rightarrow x' \in F$
In case $b = 0$, $y = x$. $\Rightarrow L$ is tangent to F at x. $\Rightarrow$ Since $Q'x$ represents the tangent plane at x, $(Q'x, L) = 0 \Rightarrow (Q'x', x') = 0 \Rightarrow x' \in F$ and $x'' \in F$.

④ $x'' \in F$

$x'' = ax + bx' \quad a, b \in \mathbb{C}$
$(Q'x'', x'') = (a\,{}^t x + b\,{}^t x') Q' (ax + bx')$
$= 2ab\,{}^t x Q' x' + b^2\,{}^t x' Q' x' = 0$ by the argument ③
$\Rightarrow x'' \in F$. $\Rightarrow$ Any elt in L is expressed as $ax + bx'$ $\Rightarrow$ By this argument,
$L \subset F$, and $L \subset G$. $\Rightarrow L \subset G \cap F$.