For $Ax = y$ with G being a generalized inverse of $A \Leftrightarrow AGA = A$

$x = Gy$ is a solution of $Ax = y$

Pre-multiply with $\Rightarrow Ax = AGy$

replace y with $Ax \Rightarrow Ax = AGAx$

$\neq \underbrace{A}_{} x$

Normal equations : $(X^TX) b^0 = X^T y$

G being a generalized inverse of (X^TX)

$\Rightarrow b^0 = GX^T y$