

Solution (#580) For $1 \leq i, j \leq 2$ we have

$$[MN]_{ij} = [A]_{i1}[E]_{1j} + [A]_{i2}[E]_{2j} + [B]_{i1}[G]_{1j} + [B]_{i2}[G]_{2j} = [AE]_{ij} + [BG]_{ij} = [AE + BG]_{ij}$$

and can find similar expressions for $[MN]_{(i+2)j}$, $[MN]_{i(j+2)}$, $[MN]_{(i+2)(j+2)}$. Hence

$$MN = \begin{pmatrix} AE + BG & AF + BH \\ CE + DG & CF + DH \end{pmatrix}.$$