4) Set $\vec{OA} = (a_1, a_2)$

$\vec{OB} = (b_1, b_2)$

$\vec{OC} = (C_1, C_2)$

$\frac{1}{2}(\vec{AB} + \vec{AC}) = \left< \frac{b_1+c_1}{2} - a_1 , \frac{b_2+c_2}{2} - a_2 \right>$

$= \vec{OA'} - \vec{OA} = \vec{AA'}$

similarly $\vec{AA'} = \frac{1}{2}(\vec{AB} + \vec{AC})$

$\vec{BB'} = \frac{1}{2}(\vec{BA} + \vec{BC})$

$\vec{CC'} = \frac{1}{2}(\vec{CA} + \vec{cB})$

$\therefore \vec{AA'} + \vec{BB'} + \vec{CC'} = 0$

$\frac{2}{3}(\vec{AA'} + \vec{BB'} + \vec{CC'}) = 0$

$\vec{MA'} + \vec{MB'} + \vec{MC'} = 0$

$\vec{OA} = \vec{OM} + \vec{MA}$

$\vec{OB} = \vec{OM} + \vec{MB}$ $\qquad \vec{OA} + \vec{OB} + \vec{OC} = 3\vec{OM}$

$\vec{OC} = \vec{OM} + \vec{MC}$ $\qquad \vec{OM} = \frac{1}{3}(\vec{OA} + \vec{OB} + \vec{OC})$

10) $\vec{DE} = \vec{A'A} = \frac{1}{2}(\vec{BA} + \vec{CA})$

$\vec{DF} = \vec{BB'} = \frac{1}{2}(\vec{BA} + \vec{BC})$

$\frac{1}{2}(\vec{DE} + \vec{DF}) = \frac{1}{4}\vec{BA} + \frac{1}{4}\vec{CA} + \frac{1}{4}\vec{BA} + \frac{1}{4}\vec{BC}$

$\vec{DD'} = \frac{3}{4} BA$

Similarly $\vec{EE'} = \frac{3}{4} Ac$

$FF' = \frac{3}{4} BC$

$\therefore$ The medians are also parallel to the sides.

11) Set $\vec{OA} = (a_1, a_2)$ $\quad \vec{OB} = (b_1, b_2)$ $\quad \vec{OC} = (C_1, C_2)$ $\quad \vec{OD} = (d_1, d_2)$

$\vec{OE} = (e_1, e_2)$

AB midpoint M $\left(\frac{a_1+b_1}{2}, \frac{a_2+b_2}{2}\right)$

CD midpoint N $\left(\frac{C_1+d_1}{2}, \frac{C_2+d_2}{2}\right)$

MN midpoint X $\left(\frac{a_1+b_1+c_1+d_1}{4}, \frac{a_2+b_2+C_2+d_2}{4}\right)$

Similarly we can get $\frac{b_1+c_1+d_1+e_1}{}$ $\frac{b_2+c_2+d_2+e_2}{}$ Y

Similarly, we can get $\left(\frac{[illegible]}{4}, \frac{[illegible]}{4} \right)$ as Y

$\vec{XY}\left(\frac{e_1 - a_1}{4}, \frac{e_2 - a_2}{4} \right) = \frac{1}{4}\vec{AE}$

12) if X lies on AB

then $\vec{XB} = \lambda \vec{AB}$ and $0 \le \lambda \le 1$

$$\vec{OB} - \vec{OX} = \lambda(\vec{OB} - \vec{OA})$$

$$\vec{OX} = \lambda \vec{OA} + \vec{OB} - \lambda \vec{OB}$$

$$= \lambda \vec{OA} + (1-\lambda)\vec{OB}$$