Step-1

In the parallelogram with corners at 0, v, w and $v+w$, we have to show that the sum of the squared lengths of the four sides equals the sum of the squared lengths of the two diagonals.

Step-2

The four corners of parallelogram are $0, v, w, v+w$.

That is, in vw-plane, the four points are

$O=(0,0)$, $A=(1,0)$, $C=(0,1)$ and $B=(1,1)$

Since A is a point on v-axis and C is a point on w-axis.

The four sides of parallelogram are OA, AB, BC, CO and the two diagonals are , AC.

Step-3

$OA=\sqrt{(1-0)^2+(0-0)^2}$
$=1$

$AB=\sqrt{(1-1)^2+(1-0)^2}$
$=1$

Step-4

$BC=\sqrt{(0-1)^2+(1-1)^2}$
$=1$

$CO=\sqrt{(0-0)^2+(0-1)^2}$
$=1$

Step-5

And

$OB=\sqrt{(1-0)^2+(1-0)^2}$
$=\sqrt{2}$

$AC=\sqrt{(0-1)^2+(1-0)^2}$
Â $=\sqrt{2}$

Step-6

The sum of the squared lengths of the four sides

$$= OA^2 + AB^2 + BC^2 + CO^2$$
$$= 4$$

The sum of the squared lengths of the two diagonals

$$= OB^2 + AC^2$$
$$= 2 + 2$$
$$= 4$$

Hence the sum of the squared lengths of the four sides is equals to the sum of the squared lengths of the two diagonals.