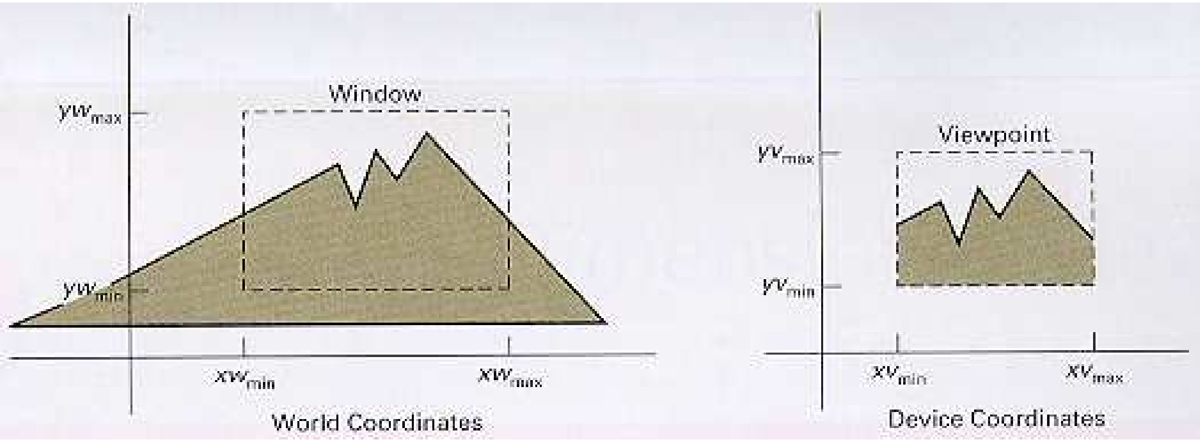
The Window-to-Viewport Transformation

- **Coordinate Systems**

  - World coordinate system

  - Screen coordinate system

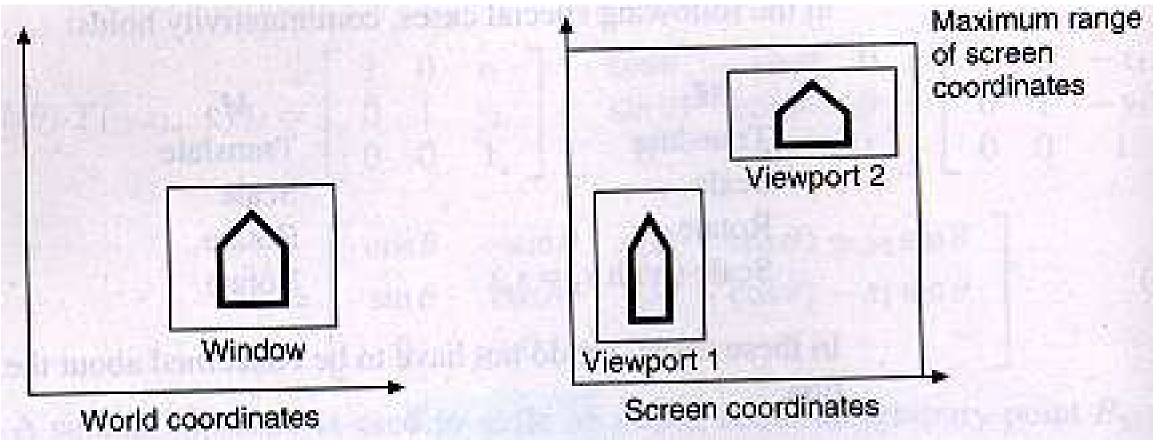


- **The viewing transformation**

  - The mapping from world coordinates to screen coordinates

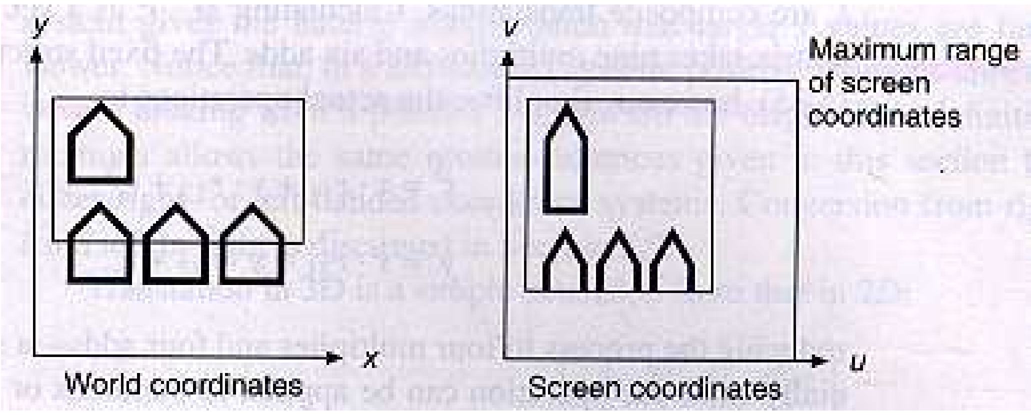
  - <u>Window:</u> it defines the area to be displayed (clipping window)

  - <u>Viewport:</u> the area on the screen to which the window is mapped

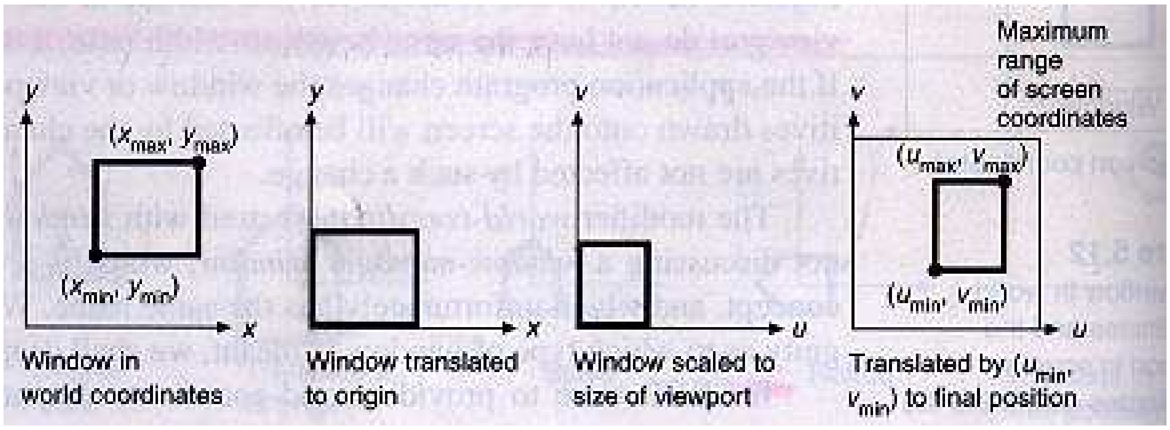


- Transformations from world to screen coordinates involve translation, rotation, scaling, and clipping

- A dramatic improvement in speed can be gained if clipping is applied before the viewing transformation



- **The transformation matrix for the viewing transformation**



$$M_{WV} = T(u_{\min}, v_{\min}) S\left(\frac{u_{\max} - u_{\min}}{x_{\max} - x_{\min}}, \frac{v_{\max} - v_{\min}}{y_{\max} - y_{\min}}\right) T(-x_{\min}, -y_{\min})$$

$$M_{WV} = \begin{bmatrix} 1 & 0 & u_{\min} \\ 0 & 1 & v_{\min} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \frac{u_{\max} - u_{\min}}{x_{\max} - x_{\min}} & 0 & 0 \\ 0 & \frac{v_{\max} - v_{\min}}{y_{\max} - y_{\min}} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -x_{\min} \\ 0 & 1 & -y_{\min} \\ 0 & 0 & 1 \end{bmatrix} =$$

$$\begin{bmatrix} \frac{u_{max} - u_{min}}{x_{max} - x_{min}} & 0 & -x_{min} \frac{u_{max} - u_{min}}{x_{max} - x_{min}} + u_{min} \\ 0 & \frac{v_{max} - v_{min}}{y_{max} - y_{min}} & -y_{min} \frac{v_{max} - v_{min}}{y_{max} - y_{min}} + v_{min} \\ 0 & 0 & 1 \end{bmatrix}$$

$$P' = M_{wv} P \quad \text{or}$$

$$P' = [(x - x_{min}) \frac{u_{max} - u_{min}}{x_{max} - x_{min}} + u_{min},\ (y - y_{min}) \frac{v_{max} - v_{min}}{y_{max} - y_{min}} + v_{min},\ 1]$$

- Note that if the window and the viewport do not have the same <u>aspect ratio</u> non-uniform scaling will occur !!