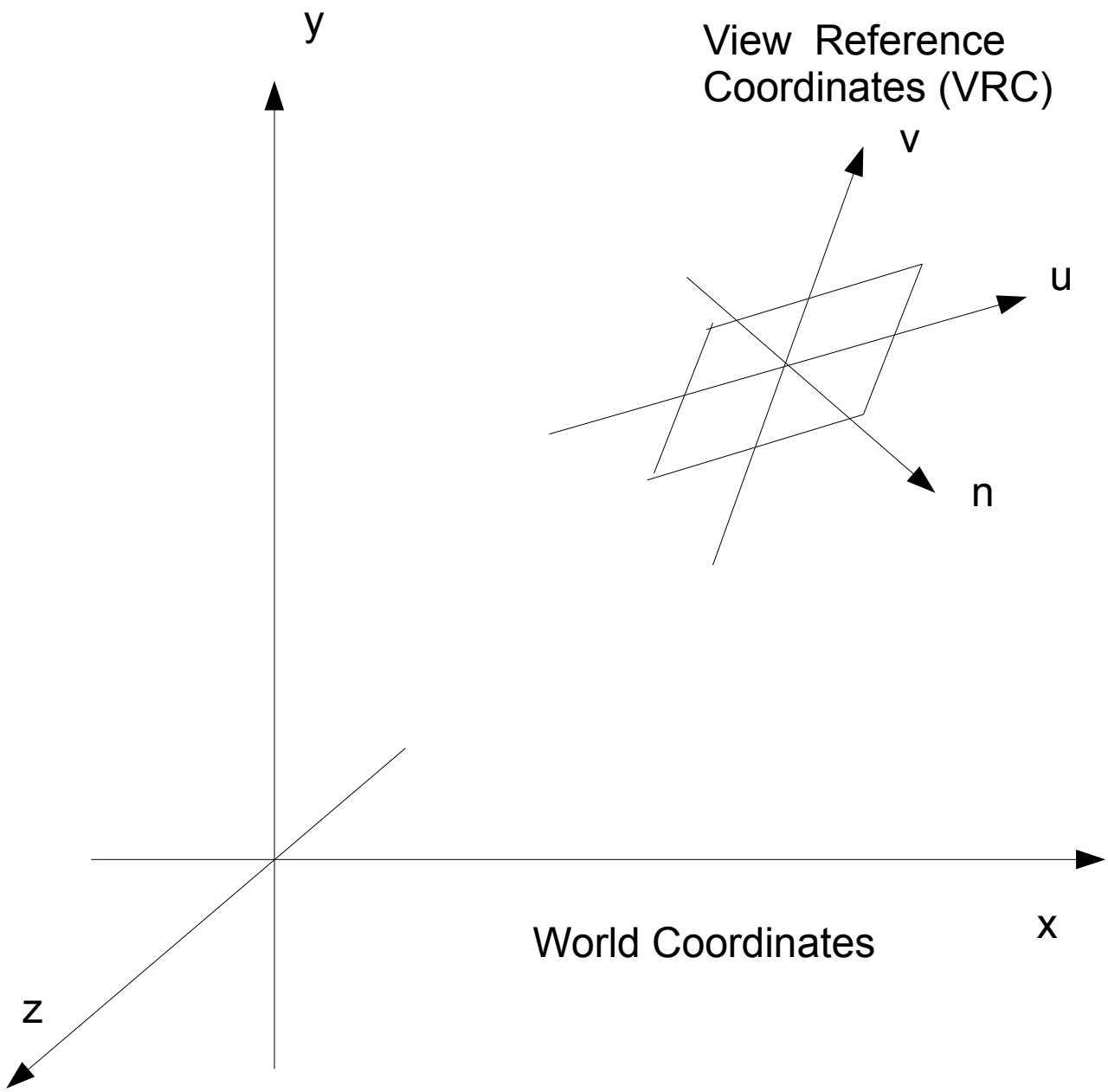
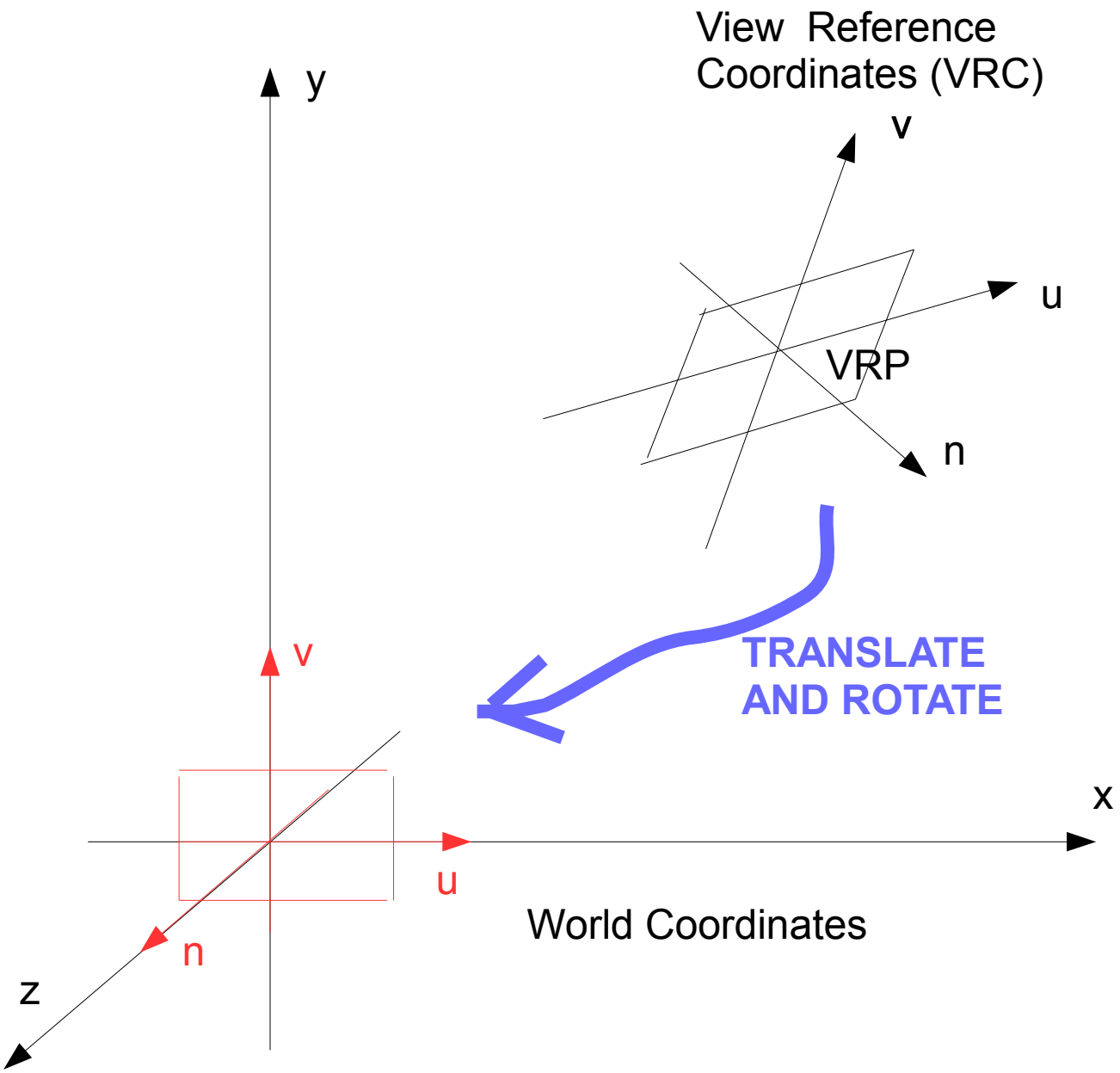


We have to

(1) translate the VRC to the origin of the World Coordinates

(2) rotate the VRC so that
u aligns with x,
v aligns with y
n aligns with z

Aligning the View Reference Coordinates with the World Coordinate System

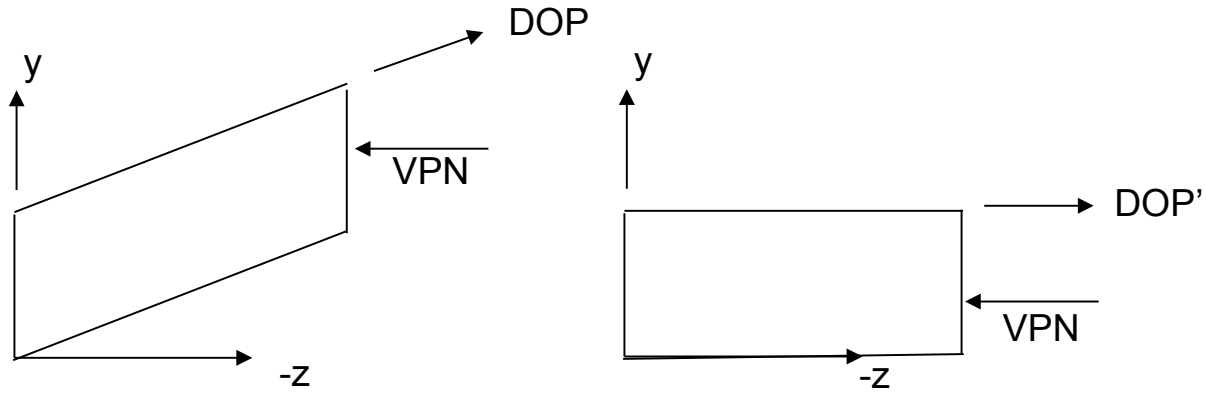


We translate the VRP to the origin of World Coords

To rotate the VRC we multiply all the points in World Space by this matrix

$$\begin{bmatrix} u_x & u_y & u_z & 0 \\ v_x & v_y & v_z & 0 \\ n_x & n_y & n_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- Shear along the *z*-axis to align the ***DOP*** with *z*-axis while maintaining the ***VPN***.



- Shear Matrix is defined as:

$$SH_{par} = SH(shx_{par}, shy_{par}) = \begin{bmatrix} 1 & 0 & shx_{par} & 0 \\ 0 & 1 & shy_{par} & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Let us give the following values to the parameters

$$shx_{par} = -\frac{dop_x}{dop_z}, \qquad shy_{par} = -\frac{dop_y}{dop_z}$$

Then we can see that multiplying the DOP by this matrix will shift the DOP to the z-axis

$$\begin{bmatrix} 1 & 0 & -dop_x/dop_z & 0 \\ 0 & 1 & -dop_y/dop_z & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} dop_x \\ dop_y \\ dop_z \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ dop_z \\ 1 \end{bmatrix}$$

Final Step
Scaling to Normalised Projection Coordinates (NPC)

- Now the bounds of the view volume are:

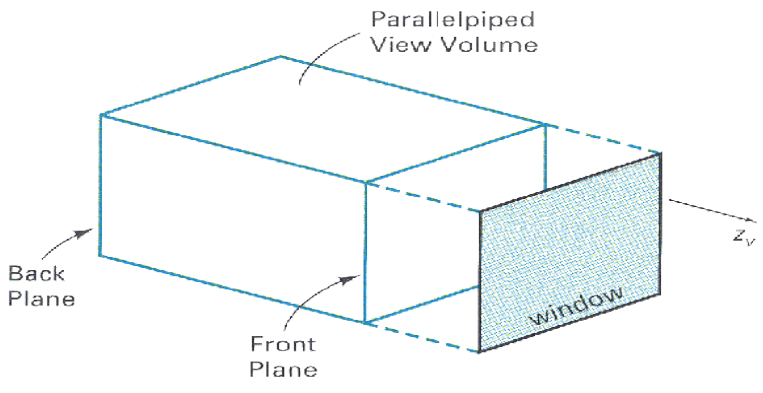
$$u_{min} \le x \le u_{max}, \quad v_{min} \le y \le v_{max}, \quad B \le z \le F$$

- We want translate and scale this volume to ***NPC*** so that the centre of the front clipping plane is at the origin, the ***NPC*** *x* and *y* values range over [-1,1] and the *z* value ranges over [0,1].

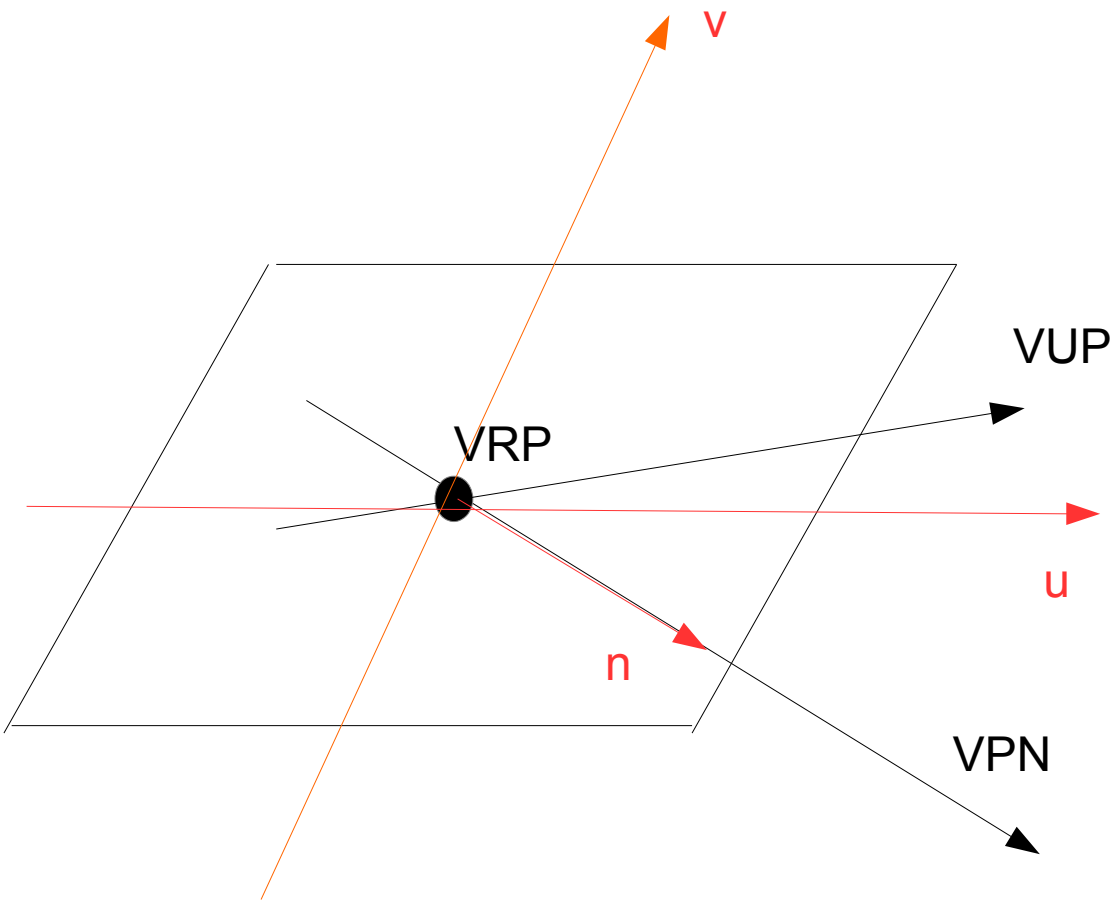
$$T_{par} = T\left(-\frac{u_{max}-u_{min}}{2}, -\frac{v_{max}-v_{min}}{2}, -F\right)$$

$$S_{par} = S\left(\frac{2}{u_{max}-u_{min}}, \frac{2}{v_{max}-v_{min}}, \frac{1}{F-B}\right)$$

Parallel Projection View Volume



H&B Figure 12.30



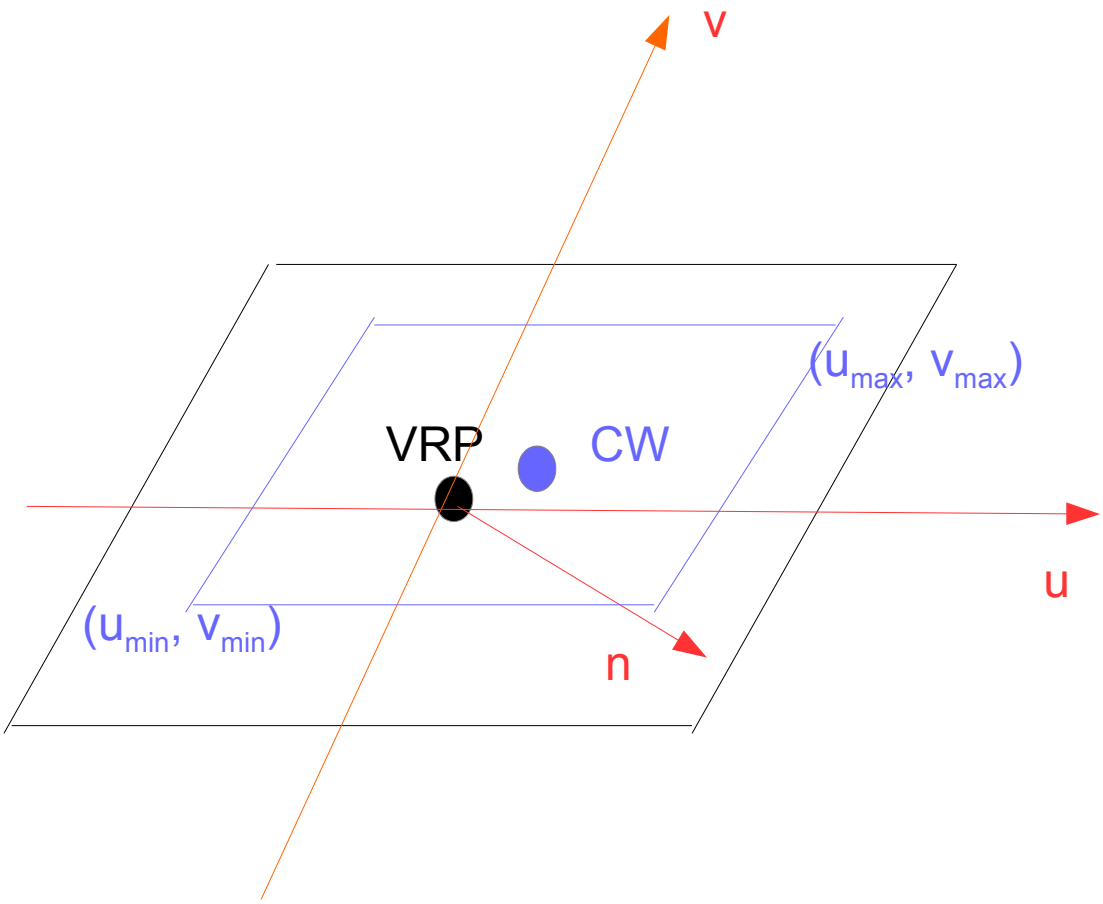
When we select a projection plane (also called a view plane) we have to select

(1) a View Plane Reference point (VRP)

(2) a View Plane Normail (VPN)

(3) a View Up vector (VUP)

From these we create the View Reference Coordinates (VRC) whose axes are u, v and n.



We have to select a View Window

The centre of the window is CW – not necessarily the same as the VRP

The sides of the View Window are given by

u_{max}, v_{max}

u_{min}, v_{min}