

# 17. 3D Object Representations

05 March 2024 05:33

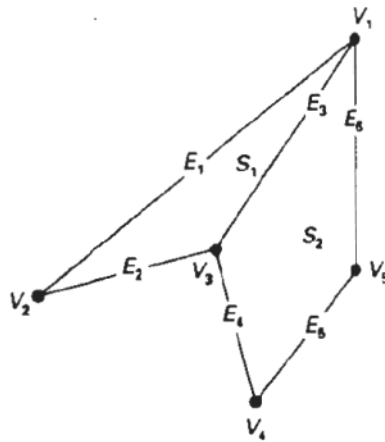
Source: Computer Graphics by Donald Hearn and M. Pauline Baker

→ No single method can be used to describe objects that includes all characteristics of these different materials.

## Representing Polygon Surfaces:-

### ① Polygon Tables

Storing geometric data using three tables,



VERTEX TABLE	
$V_1$ :	$x_1, y_1, z_1$
$V_2$ :	$x_2, y_2, z_2$
$V_3$ :	$x_3, y_3, z_3$
$V_4$ :	$x_4, y_4, z_4$
$V_5$ :	$x_5, y_5, z_5$

EDGE TABLE	
$E_1$ :	$V_1, V_2$
$E_2$ :	$V_2, V_3$
$E_3$ :	$V_3, V_1$
$E_4$ :	$V_3, V_4$
$E_5$ :	$V_4, V_5$
$E_6$ :	$V_5, V_1$

POLYGON-SURFACE TABLE	
$S_1$ :	$E_1, E_2, E_3$
$S_2$ :	$E_3, E_4, E_5, E_6$

### ② Plane Equations

The equation for a plane surface,

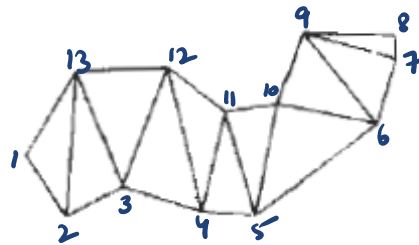
$$Ax + By + Cz + D = 0$$

$(x, y, z)$  is any point on the plane.

$A, B, C, D$  are constants describing the spatial properties of the plane.

### ③ Polygon Meshes

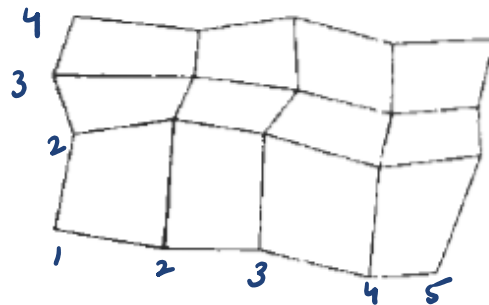
Triangle Mesh:-



A triangle strip formed with 11 triangles connecting 13 vertices.

$\Rightarrow$  produces  $(n-2)$  connected triangles.

Quadrilateral Mesh:-



12 quadrilaterals constructed from a 5 by 4 input vertex array.

⇒ A mesh of  $(n-1)$  by  $(m-1)$  quadrilaterals.

## Spline Representation :-

Spline :- a flexible strip used to produce a smooth curve through a designated set of points.

## Interpolation and Approximation Splines :-

Control Points :- Set of coordinate positions which indicates the general shape of a curve.

⇒ Fitting the polynomial so that the curve passes through each control point.

⇒ Polynomials are fitted to the control point path without necessarily passing through any control point.



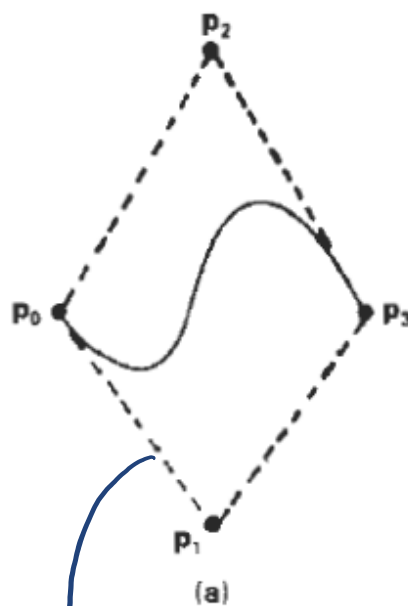
Interpolated  
control points



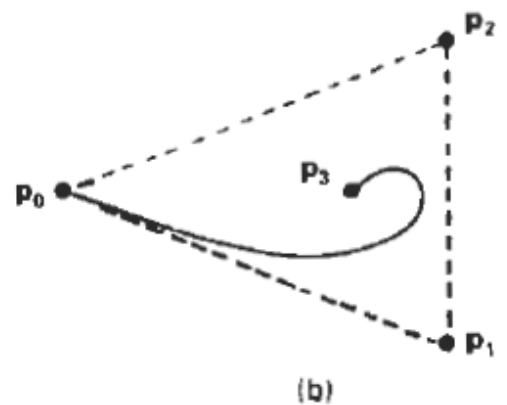
Approximated  
control points

### CONVEX HULL :-

The convex polygon boundary that encloses a set of control points is called convex hull.



Convex hull



shape