UNIT II
GEOMETRIC MODELLING

Synthetic surfaces and representations:
The curve that goes through the data points are called is called synthetic curve.
The components of synthetic curves are

- Hermit cubic spline curve
- Bezier curve
- B-spline curve

Hermit curve:

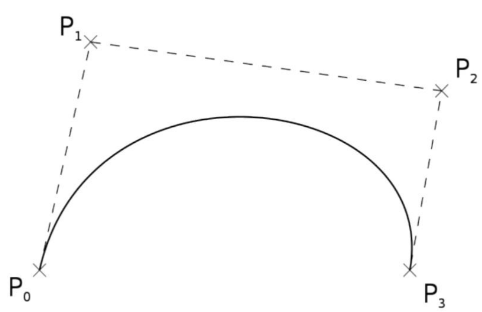
Hermite Specification

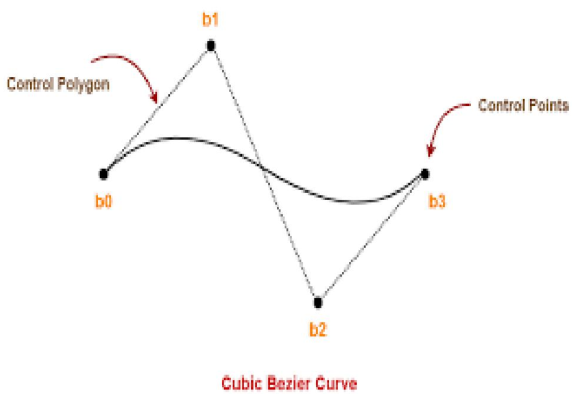
HCC is defined by defining 2position vectors and 2 tangent vectors at data points Hermit cube curve is also called as parametric cube curve and cubic spline
The curve is used to interpolate given data points but not free form curve
The most commonly used, cubic spline is a 3D planer curve It is represented by cubic polynomial
Several splines can be joined together by imposing slope continuity at the corner points. The parametric equation for a cubic spline is given by

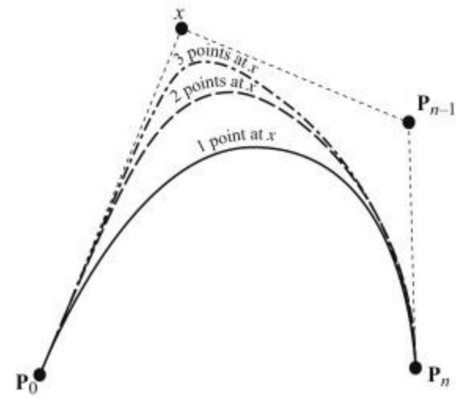
P u = 3 a u (1)

=00<ui<i1

Bezier curve:







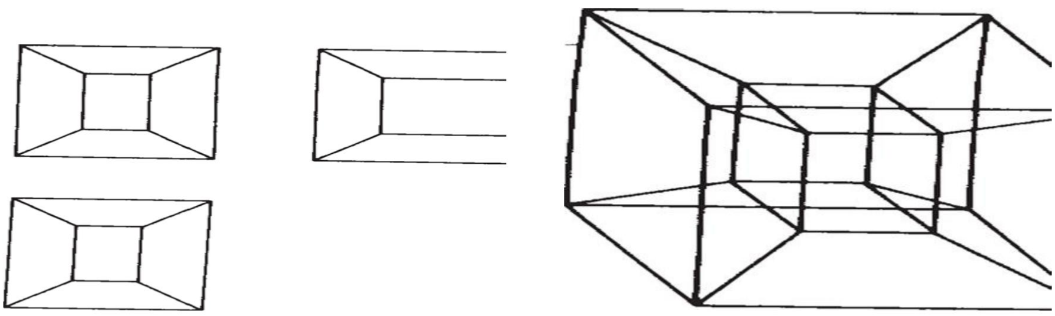
It is a parametric curve used in computer graphics and related fields. A set of discrete "control points" defines a smooth, continuous curve by means of a formula. Usually the curve is intended to approximate a real-world shape that otherwise has no mathematical representation or whose representation is unknown or too complicated. The Bézier curve is named after French engineer Pierre Bézier (1910–1999), who used it in the 1960s for designing curves for the bodywork of Renault cars.Other uses include the design of computer fonts and animation.Bézier curves can be combined to form a Bézier spline, or generalized to higher dimensions to form Béziersurfaces.The Bézier triangle is a special case of the latter.

In vector graphics, Bézier curves are used to model smooth curves that can be scaled indefinitely. "Paths", as they are commonly referred to in image manipulation programs,are combinations of linked Bézier curves. Paths are not bound by the limits of rasterized images and are intuitive to modify.

Bézier curves are also used in the time domain, particularly in animation,user interface design and smoothing cursor trajectory in eye gaze controlled interfaces.[5] For example, a Bézier curve can be used to specify the velocity over time of an object such as an icon moving from A to B, rather than simply moving at a fixed number of pixels per step. When animators or interface designers talk about the "physics" or "feel" of an operation, they may be referring to the particular Bézier curve used to control the velocity over time of the move in question.

WIRE FRAME MODELING

Most current day graphics systems use a form of modeling called wire-frame modeling. In the construction of the wire-frame model the edges of the objectsare shown as lines. For objects in which there are curved surfaces, contour lines canbeadded;asshowninFigure,toindicatethecontour.Theimageassumestheappearanceofa frameconstructedout ofwire-hencethename “wireframe”model.



Solid model:

An improvement over wire-frame models, both in terms of realism to the user and definition to the computer, is the solid modeling approach. In this approach, the models are displayed as solid objects to the viewer, with very little risk of misinterpretation. When color is added to the image, the resulting picture becomes strikingly realistic. It is anticipated that graphics systems with this capability will find a wide range of applications outside computer-aided design and manufacturing. These applications will include' color illustrations in magazines and technical publications, animation in movie films, and training simulators (e.g., aircraft pilot training).

There are two factors which promote future widespread use of solid modelers (i.e., graphics systems with the capability for solid modeling). The first is the increasing awareness among users of the limitations of wire-frame systems. As powerful as today's wire-frame-based CAD systems have become, solid model systems represent a dramatic improvement in graphics technology. The second reason is the continuing development of computer hardware and software which make solid modeling possible. Solid modelers require a great deal of computational power, in terms of both speed and memory, in order to operate.

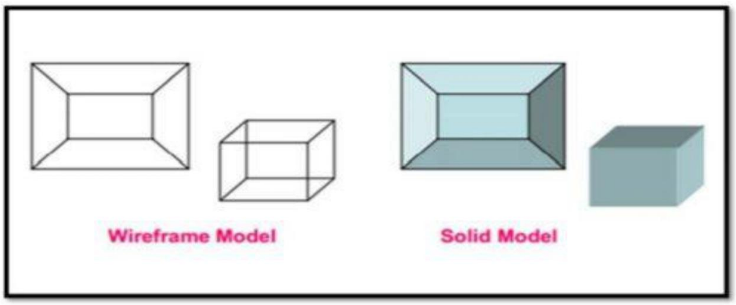
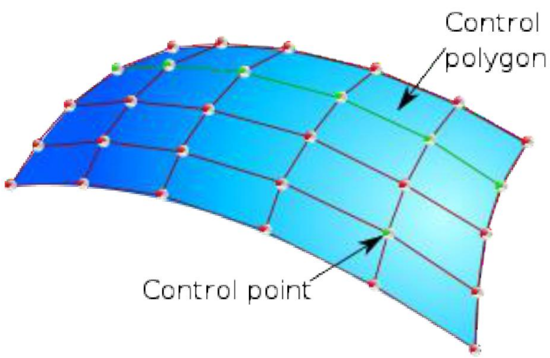


Fig: 4.1 Solid Model

Surface model:

Surface Modeling is **the method of showing or presenting solid objects**. The process requires you to convert between different 3D modeling types, such as converting the 3D object to show procedural surfaces, validate imperfections, and apply smoothness.



Solid modeling:

Solid modeling is based on *complete, valid and unambiguous* geometric representation of physical object.

- Complete points in space can beclassified. (inside/ outside)
- Valid vertices, edges, faces areconnected properly.
- Unambiguous there can only beone interpretation of object

Solid model representation:

1) Constructive solid geometry (CSG)
2) Boundary representation (B-rep)
3) Spatial enumeration
4) Instantiation.

1) Constructive solid geometry:

- Objects are represented as a combinationof simpler solid objects (*primitives*).
- The primitives are such as cube, cylinder, cone, torus, sphere etc.
- Copies or "instances" of these primitive shapes are created and positioned.
- A complete solid model is constructed by combining these "instances" using set specific, logic operations (Boolean)

Boolean operation:

Each primitive solid is assumed to be a set of points, a boolean operation is performed on point sets and the result is a solid model.

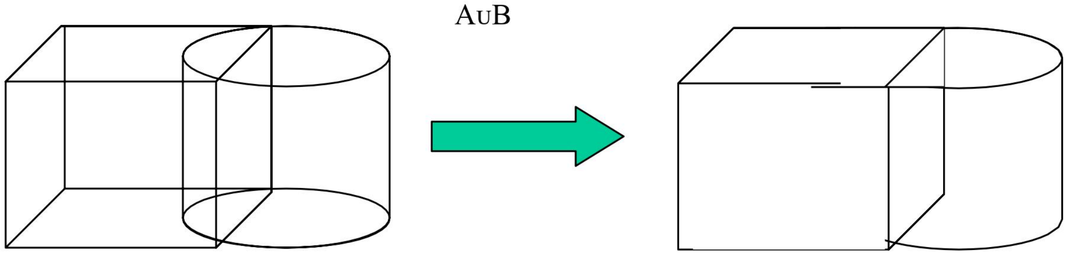
Boolean operation union, intersectionand difference

The relative location and orientation of the two primitives have to be defined before the boolean operation can be performed.Boolean operation can be applied to two solids other than the primitives.

1) Union
   - The sum of all points in each of two defined sets. (logical "OR")
   - Also referred to as Add, Combine, Join, Merge

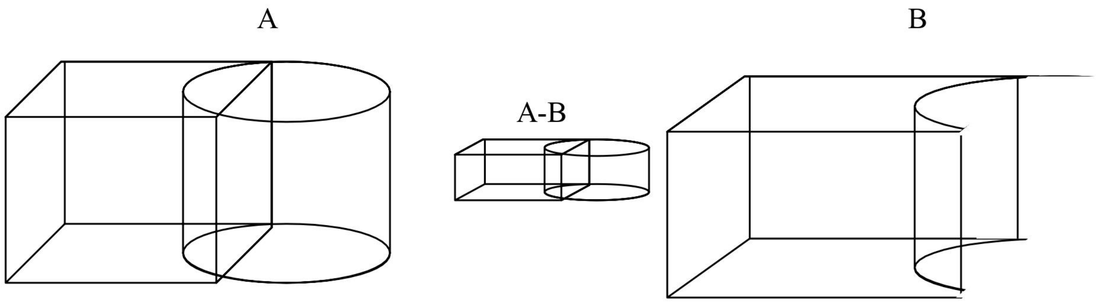
A B

A∪B



2) Difference

- The points in a source set minus the points common to a second set. (logical "NOT")
- Set must share common volume
- Also referred to as subtraction, remove, cut



3) Intersection

- Those points common to each of two defined sets (logical "AND")
- Set must share common volume
- Also referred to as common, conjoin