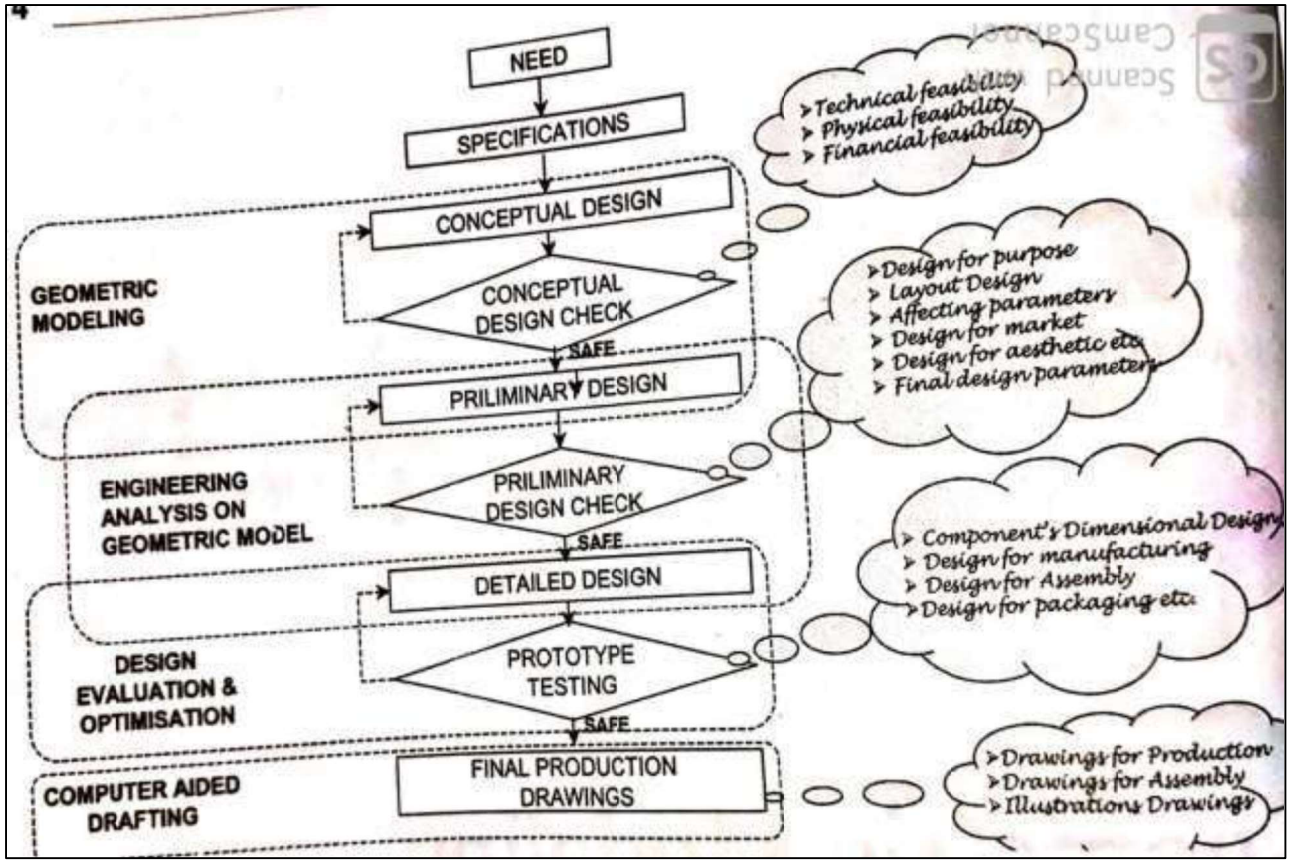
GEOMETRIC MODELING

- Geometric modeling refers to a set of techniques concerned mainly with developing efficient representations of geometric aspects of a design. Therefore, geometric modeling is a fundamental part of all CAD tools.



Geometric modeling is the basic of many applications such as:

- Mass property calculations.
- Mechanism analysis.
- Finite-element modeling.
- NC programming.

Requirements of geometric modeling include:

- Completeness of the part representation.
- The modeling method should be easy to use by designers.
- Rendering capabilities (which means how fast the entities can be accessed and displayed by the computer).

Geometric Modeling Approaches or Type

The basic geometric modeling approaches available to designers on CAD/CAM systems are:

1. Wire-frame modeling.
2. Surface modeling.
3. Solid modeling.

Wire-frame model

- A **wire-frame model** is a visual presentation of a 3-dimensional (3D) or physical object used in 3D computer graphics. It uses points and curves (i.e. lines, circles, arcs) by connecting them using their point of coordinates or vertices.

- It is created by specifying each edge of the physical object where two mathematically continuous smooth surfaces meet, or by connecting an object's constituent vertices using straight lines or curves. Ex: Auto CAD, VersaCAD

Surface Modeling

- A **Surface modeling** is more sophisticated than wireframe modeling in that it defines not only the edges of a 3D object, but also its surfaces. In surface modeling, objects are defined by their bounding faces. The surface are created by connected by connecting lines.
- A model of this type is used for representing only surface like sheet metals covers, car body exteriors etc.
- Surface modeling software: Neoform, Pro-E and CATIA etc

SURFACE ENTITIES

Similar to wireframe entities, existing CAD/CAM systems provide designers with both analytic and synthetic surface entities.

- **Analytic entities include** :
  - •Plane surface,
  - •Ruled surface,
  - •Surface of revolution, and
  - •Tabulated cylinder.
- **Synthetic entities include**
  - •The bi-cubic hermite spline surface,
  - •B-spline surface,
  - •Rectangular and triangular Bezier patches,
  - •Rectangular and triangular Coons patches, and
  - •Gordon surface.

Plane surface. This is the simplest surface. It requires three non-coincident points to define an infinite plane.

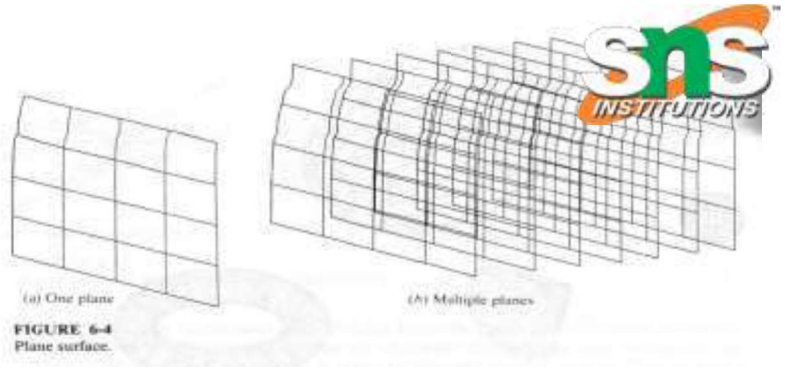
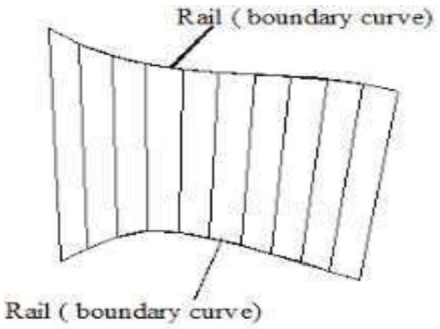


FIGURE 6-4
Plane surface.

- ***Ruled (lofted) surface***. This is a linear surface. It interpolates linearly between two boundary curves that define the surface (rails). Rails can be any wireframe entity. This **entity is ideal to**
- **represent surfaces that do not have any twists or kinks.**



- ***Surface of revolution***. This is an axisymmetric surface that can model axisymmetric objects. It is generated by rotating a planar wireframe entity in space about the axis of symmetry a certain angle.

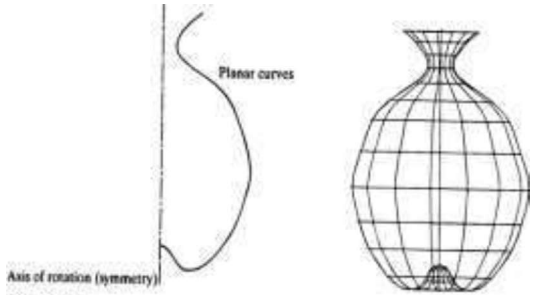


FIGURE 6-6
Surface of revolution.

- ***Tabulated cylinder***. This is a surface generated by translating a planar curve a certain distance along a specified direction (axis of the cylinder).

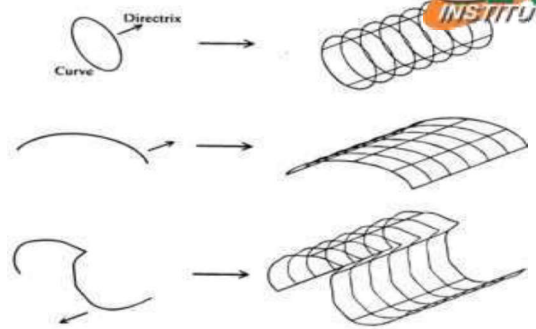


FIGURE 6-7
Tabulated cylinder.

- ***Bezier surface***. This is a surface that approximates given input data. It is different from the previous surfaces in that it is a synthetic surface. Similarly to the Bezier curve, it does not pass through all given data points. It is a general surface that permits, twists, and kinks . The Bezier surface allows only global control of the surface.

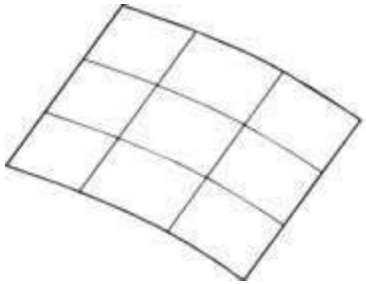
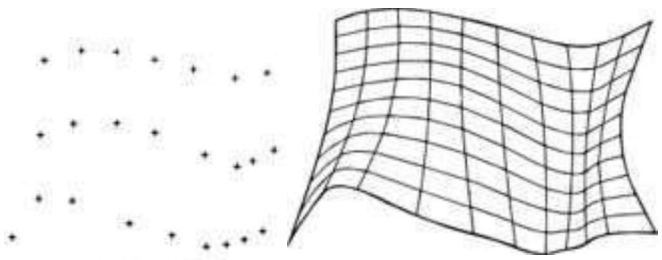


FIGURE 6-8
Bezier surface

- ***B-spline surface***. This is a surface that can approximate or interpolate given input data It is a synthetic surface. It is a general surface like the Bezier surface but with the advantage of permitting local control of the surface.


(a) Data points

Solid Modeling

- Solid models give designers a complete descriptions of constructs, shape, surface, volume, and density. Or we can say A three dimensional model incudes the complete internal and external detail and from this type of model, all sort of information of the solid may be accessed for mass property calculation, Analysis, manufacturing, inspection and quality control etc.
- Solid modeling software: Solidworks, Inventor etc.