https://sites.google.com/a/carnegiedigital.com/cad-3d-modelling/theory

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| **WIRE FRAME MODEL**Definition: a technique for representing 3D objects, in which all surfaces are visibly outlined in lines, including the opposite sides and all internal components that are normally hidden from view. Compared to surface and solid modeling, wireframe modeling is the least complex method for representing 3D images.A wire frame model is a visual presentation of a three dimensional or physical object 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](http://en.wikipedia.org/wiki/Vertex_%28computer_graphics%29) using straight lines or curves. The object is projected onto the computer screen by drawing lines at the location of each edge.The term wireframe comes from designers using metal wire to represent the 3 dimensional shape of solid objects.3D wireframe allows to construct and manipulate solids and solid surfaces.3D solid modeling technique efficiently draws high quality representation of solids than the conventional line drawing.Using a wire frame model allows visualization of the underlying design structure of a 3D model. Traditional 2-dimensional views and drawings can be created by appropriate rotation of the object and selection of hidden line removal via cutting planes.Since wireframe renderings are relatively simple and fast to calculate, they are often used in cases where a high screen frame rate is needed (for instance, when working with a particularly complex 3D model, or in real-time systems that model exterior phenomena). When greater graphical detail is desired, surface textures can be added automatically after completion of the initial rendering of the wireframe. This allows the designer to quickly review chansolids or rotate the object to new desired views without long delays associated with more realistic [rendering](http://en.wikipedia.org/wiki/Rendering_%28computer_graphics%29).**Uses of wire frame**1. Viewing the model from any desired point-This can be obtained by changing line of sight.
2. To produce standard orthographic and auxillary views:-Orthographic views are created by changing the line of sight so that it is perpendicular to the front,top and profile faces of the model for creating front view(elevation),top view(plan) and side view respectively.After the orthographic views are created,they must be edited to remove extraneous lines and to add hidden and centre lines so the drawing conforms with the standards.
3. To produce exploded and perspective view more easily.
4. To analyse distances within the structure and checking tolerances and interference.
5. To decrease number of prototypes required.
6. Editing the model:-Some CAD systems can automatically remove hidden lines using a command called hide.

**Ambiguity of wire models**Difficult to know if the direction of an opening is front,back,sideways or any other direction e.g. a cube with circular holes.  Hence this model of cube does not allow free interpretation**SURFACE MODEL** Definition: A mathematical technique for representing solid-appearing objects. Surface modeling is a more complex method for representing objects than wireframe modeling, but not as sophisticated as solid modeling. Surface modeling is widely used in CAD (computer-aided design) for illustrations and architectural renderings. Although surface and solid models appear the same on screen, they are quite different. Surface models cannot be sliced open as can solid models. In addition, in surface modeling, the object can be geometrically incorrect; whereas, in solid modeling, it must be correct.CAD software packages use two basic methods for the creation of surfaces. The first begins with construction curves ([splines](http://en.wikipedia.org/wiki/Splines)) from which the 3D surface is then swept (section along guide rail) or meshed (lofted) through. The second method is direct creation of the surface with manipulation of the surface poles/control points. From these initially created surfaces, other surfaces are constructed using either derived methods such as offset or angled extensions from surfaces; or via bridging and blending between groups of surfaces.  Freeform surfaces do not have rigid radial dimensions, unlike regular surfaces such as planes, cylinders and conic surfaces; control points of a surface define its shape.**SOLID MODEL****Definition:** A mathematical technique for representing solid objects. Unlike wireframe and surface modeling, solid modeling systems ensure that all surfaces meet properly and that the object is geometrically correct. Solid models allow for interference checking, which tests to see if two or more objects occupy the same space.Solid modeling is the most complicated of the CAD technologies, because it simulates an object internally and externally. Solid models can be sectioned (cut open) to reveal their internal features, and they can be stress tested as if they were physical entities in the real world.**Solid Modeling** is a modeling that provides a complete representation of an object than a wire frame modeling and surface modeling. In this model, the appearance of an object is displayed in solid design. The solid model can be made very realistic by adding colors to the images. Solid modeling can be created and modified very quickly when compared to other types of modeling. Constructive Solid Geometry (CSG), Boundary Representation (B – Rep) are two approaches that are generally used to create a solid model.Solid modeling (or modelling) is a consistent set of principles for mathematical and computer modeling of three-dimensional solids. Solid modeling is distinguished from related areas of geometric modeling and computer graphics by its emphasis on physical fidelity.Together, the principles of geometric and solid modeling form the foundation of computer-aided design and in general support the creation, exchange, visualization, animation, interrogation, and annotation of digital models of physical objects.**CONSTRUCTIVE SOLID GEOMETRY**Constructive Solid Geometry system is also known as ‘Building Block’ approach. The CSG approach allows the designers to construct a model with the use of graphics primitives like cubes, rectangular blocks, pyramids, cylinders, and spheres. The solid graphic primitives are integrated to construct the solid model using Boolean Operations. Union, Intersection, and Difference are the three different Boolean operators used to construct a solid model.Defined by the combination of solid primitives e.g. box, cylinder. Constructive solid geometry (CSG) connotes a family of schemes for representing rigid solids as Boolean constructions or combinations of primitives via the regularized set operations. CSG and boundary representations are currently the most important representation schemes for solids. CSG representations are particularly useful for capturing design intent in the form of features corresponding to material addition or removal. The attractive properties of CSG include conciseness, guaranteed validity of solids, computationally convenient Boolean algebraic properties, and natural control of a solid's shape in terms of high level parameters defining the solid's primitives and their positions and orientations.BOUNDARY REPRESENTATIONBoundary Representation (B – Rep) approach allows the designer to draw a boundary or an outline of an object in the CRT screen for displaying various views like left side view, top view, and front view. The boundaries of the views are interlinked with edges, faces and vertices.Objects represented in terms of spatial boundaries.  A solid is represented by the cellular decomposition of its boundary. Since the boundaries of solids have the distinguishing property that they separate space into regions defined by the interior of the solid and the complementary exterior; every point in space can unambiguously be tested against the solid by testing the point against the boundary of the solid.  The assumption of boundaries as manifold cell complexes forces any boundary representation to obey disjointedness of distinct primitives, i.e. there are no self-intersections that cause non-manifold points. In particular, the manifoldness condition implies all pairs of vertices are disjoint, pairs of edges are either disjoint or intersect at one vertex, and pairs of faces are disjoint or intersect at a common edge.  In addition to planar faces, modern systems provide the ability to store quadrics and [NURBS](http://en.wikipedia.org/wiki/Nurbs)surfaces as a part of the boundary representation.**Advantages of Solid Modeling:*** Complete modeling.
* Unambiguous.
* Best suitable for calculating mass properties.
* Very much suitable for automated applications.
* Fast creation.
* Gives huge information.

**Disadvantages of Solid Modelling:*** Requires large memory.
* Slow manipulation.

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**Points to consider:**

* Advantages and disadvantages of wire models, surface models and solid models
* What are the differences between the models? e.g. physical properties,  etc
* What methods are used to construct the different types of models? e.g. principles of construction etc