

Rapid Prototyping

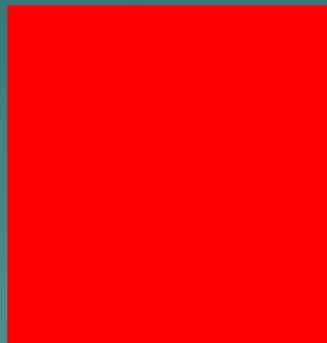
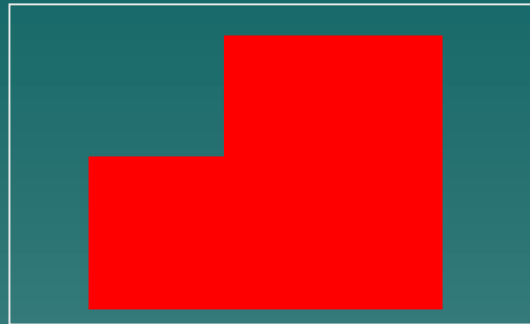
Dr. Pulak M. Pandey

<http://paniit.iitd.ac.in/~pmpandey>

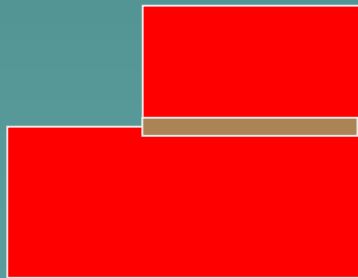
Prototyping

- ◆ Prototyping or model making is one of the important steps to finalize a product design. It helps in conceptualization of a design. Before the start of full production a prototype is usually fabricated and tested.
- ◆ Manual prototyping by a skilled craftsman has been an age-old practice for many centuries.
- ◆ Second phase of prototyping started around mid-1970s, when a soft prototype modeled by 3D curves and surfaces could be stressed in virtual environment, simulated and tested with exact material and other properties.
- ◆ Third and the latest trend of prototyping, i.e., Rapid Prototyping (RP) by layer-by-layer material deposition, started during early 1980s with the enormous growth in Computer Aided Design and Manufacturing (CAD/CAM) technologies.

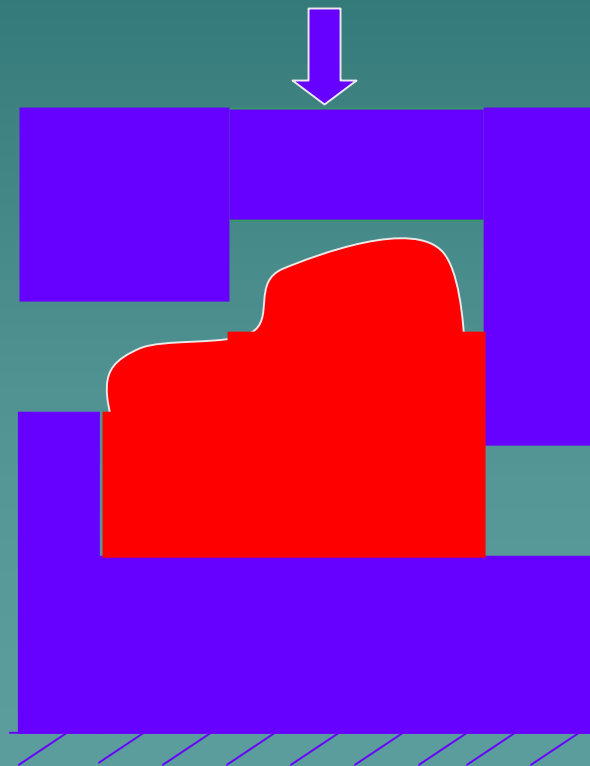
Product Fabrication Approaches



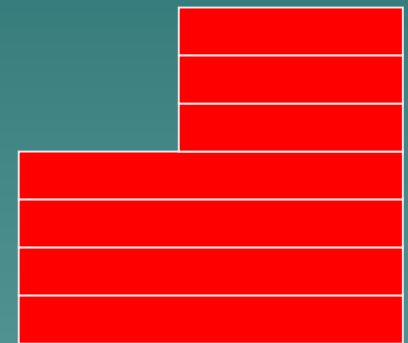
Machining



Joining

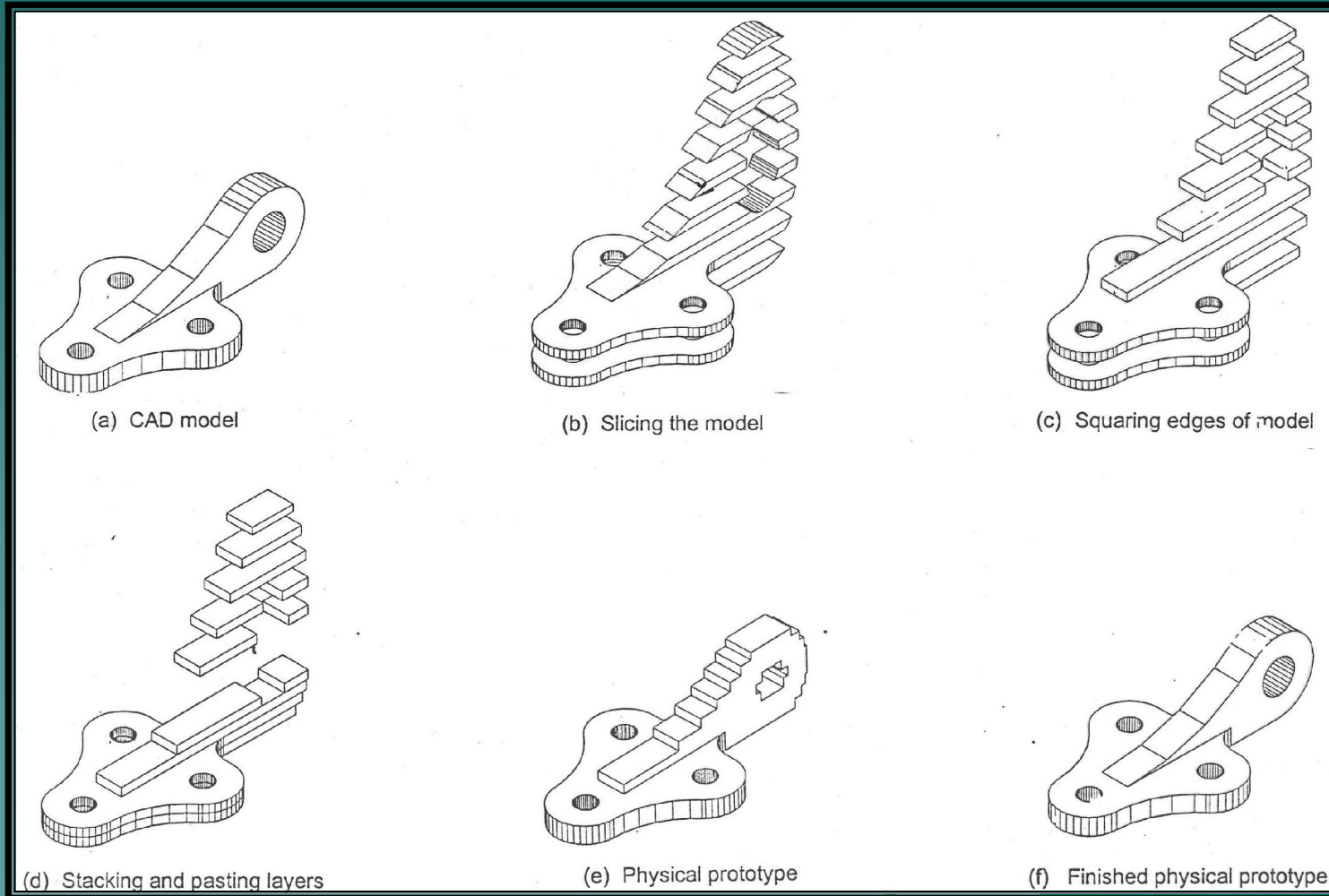


Forming

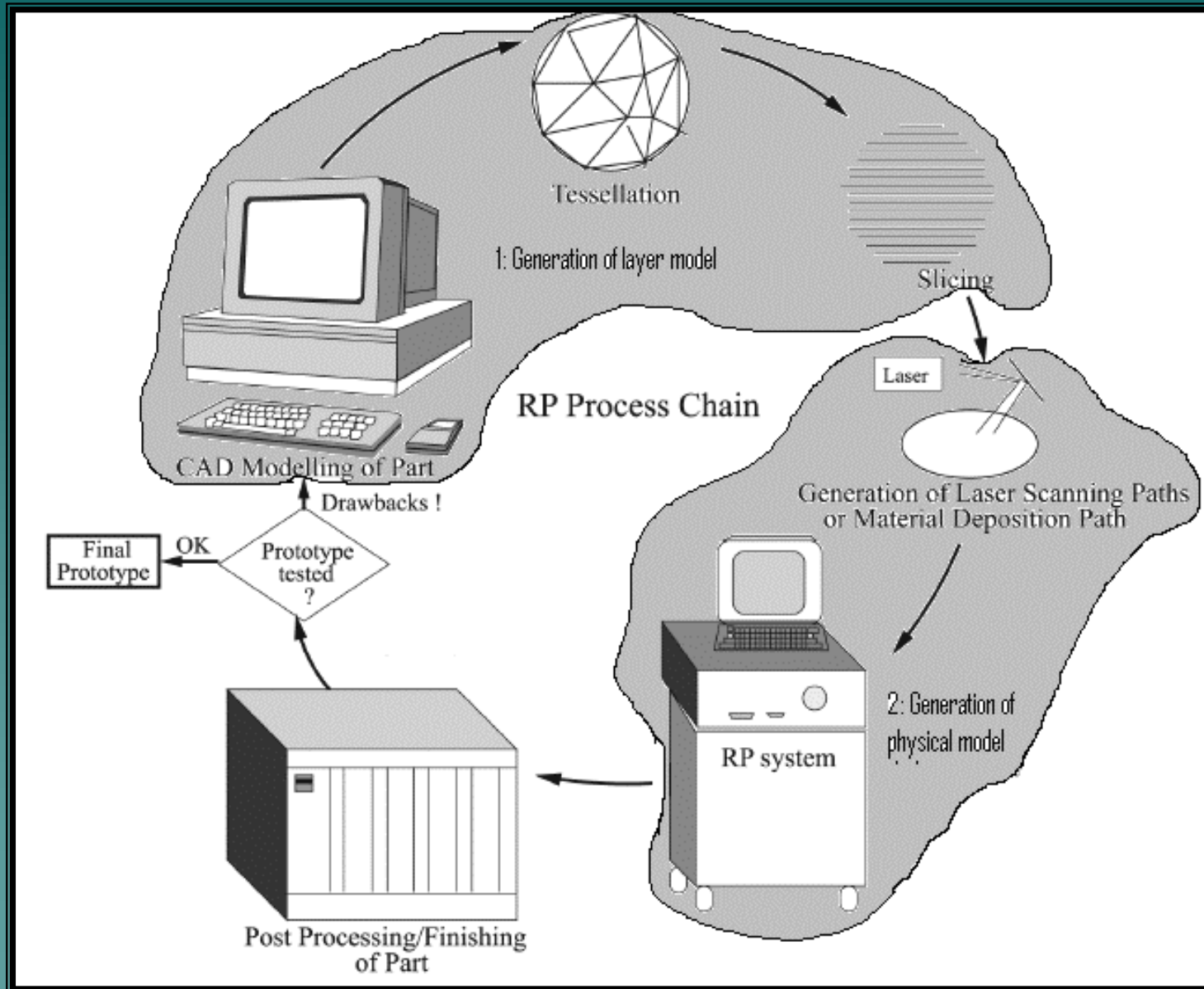


Layer Deposition or
Rapid Prototyping

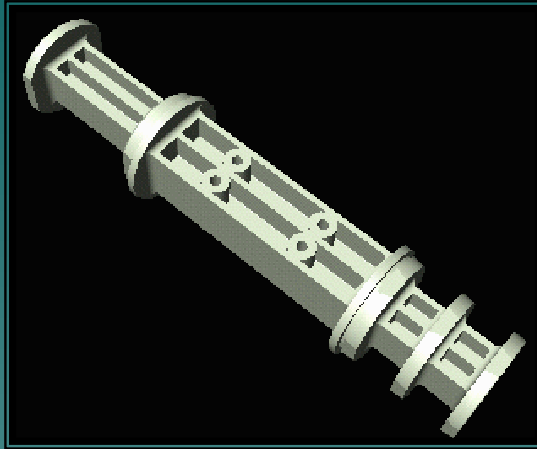
RP uses layer by layer additive approach to build shapes,
RP systems use liquid, powder or sheet materials to form
physical objects.



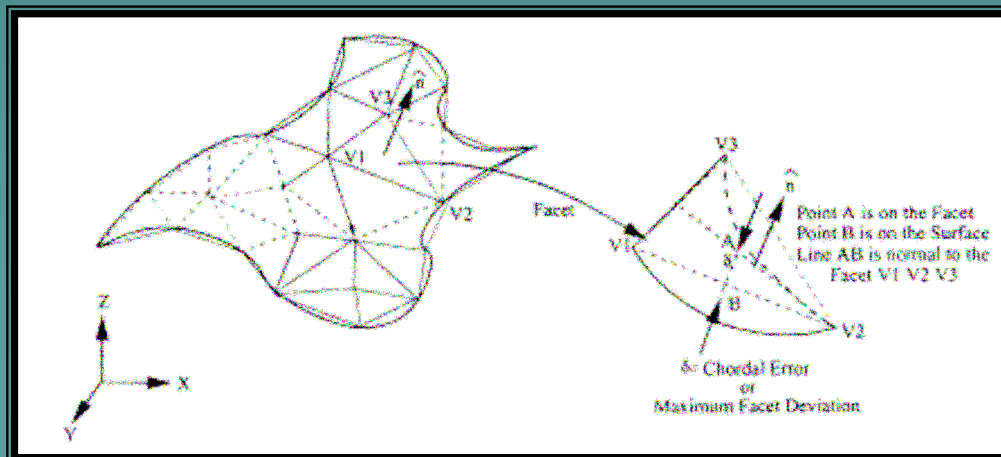
Basic Principal of Rapid Prototyping



Step 1: Solid Modeling and Tessellation

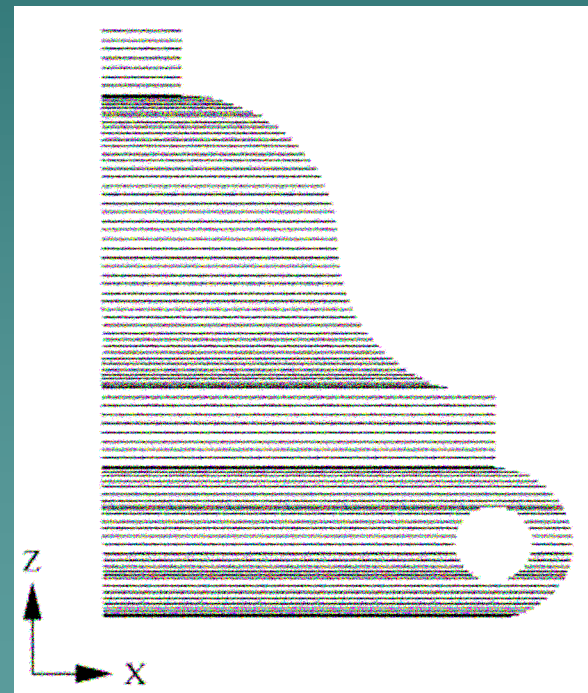
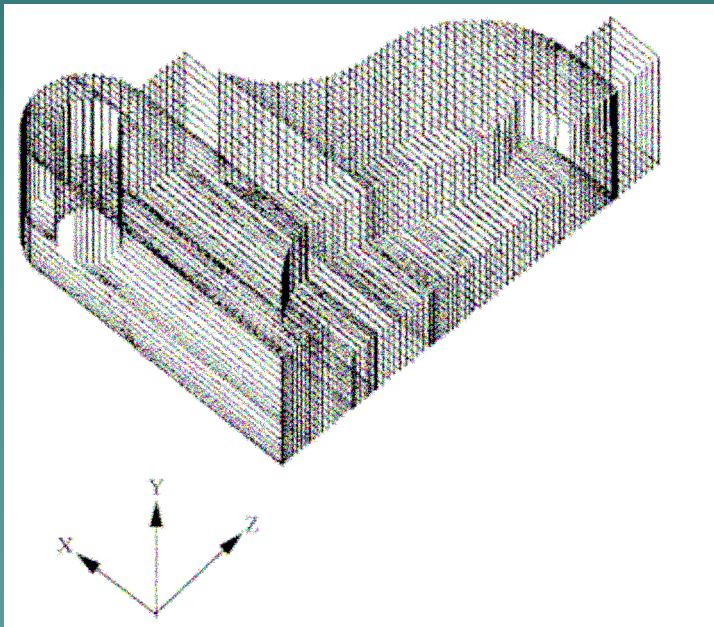


Surfaces of the CAD model are tessellated and STL file is exported. Tessellation is piecewise approximation of surfaces of CAD model by using series of triangles.



Step 2: Slicing

- ◆ After selecting part deposition orientation, tessellated model is sliced.
- ◆ This information is saved in standard formats like SLC or CLI etc.



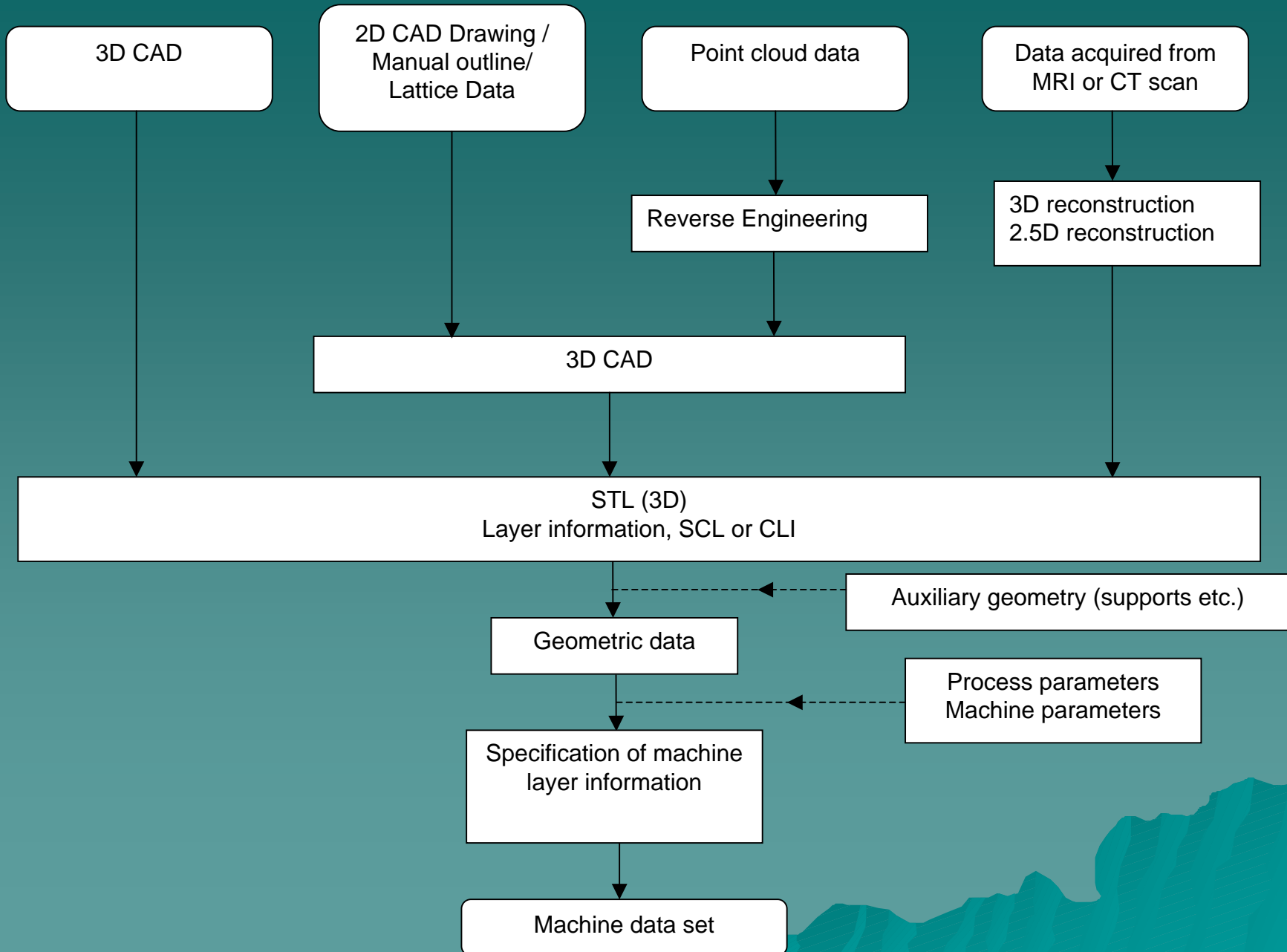
Step 3

- ◆ Generation of Laser Scanning Paths or Material Deposition Paths
- ◆ Deposition of Layers: various technologies for layer deposition are used
 - Liquid based: Stereolithography
 - Powder based: Selective Laser Sintering
 - Solid based: Fused Deposition Modeling, Laminated Object Manufacturing etc.

Step 4: Post processing

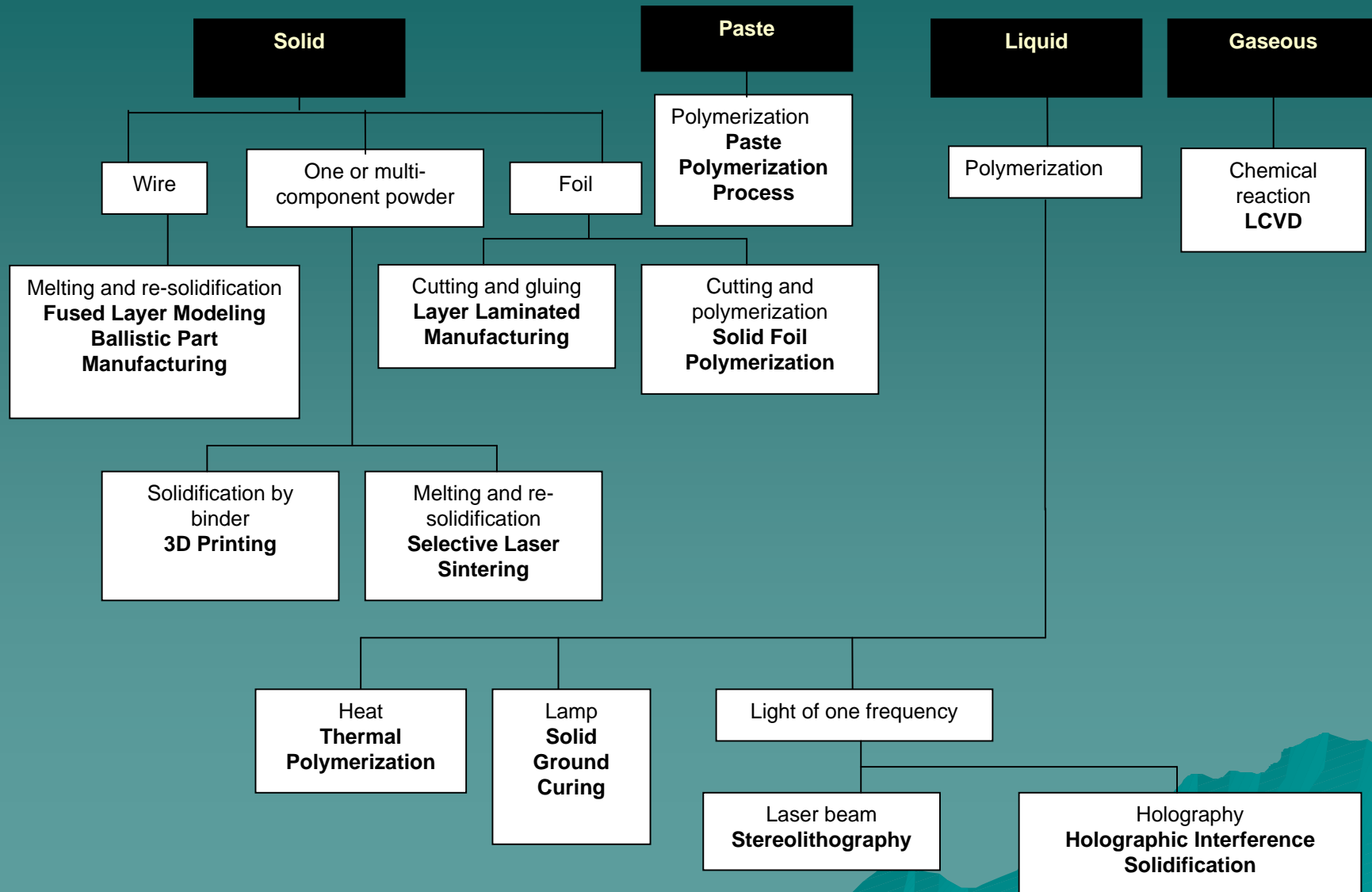
- ◆ Post curing
- ◆ Removal of support structure
- ◆ Finishing by sanding/polishing or painting

Generalized illustration of data flow in RP

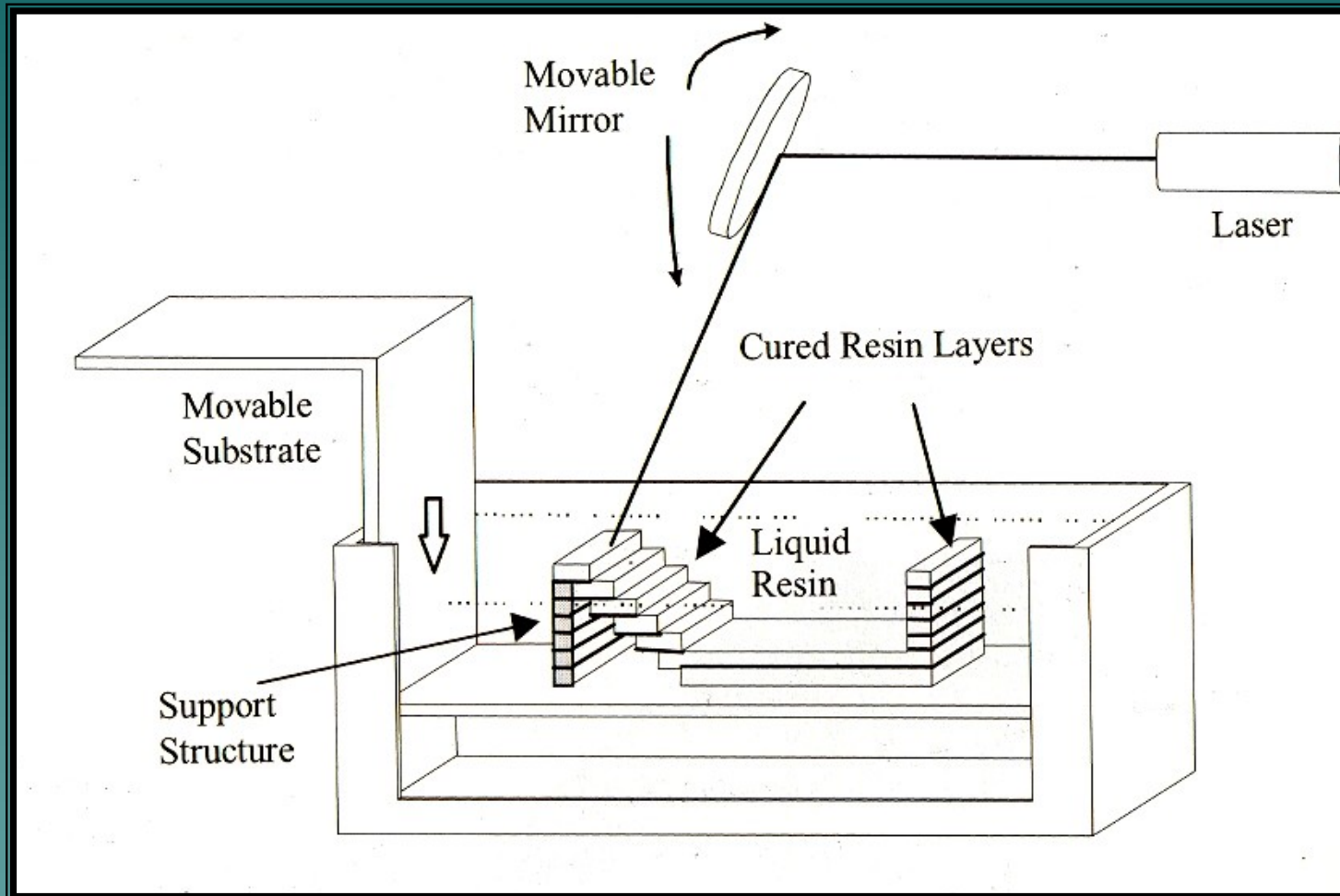


Classification of RP processes

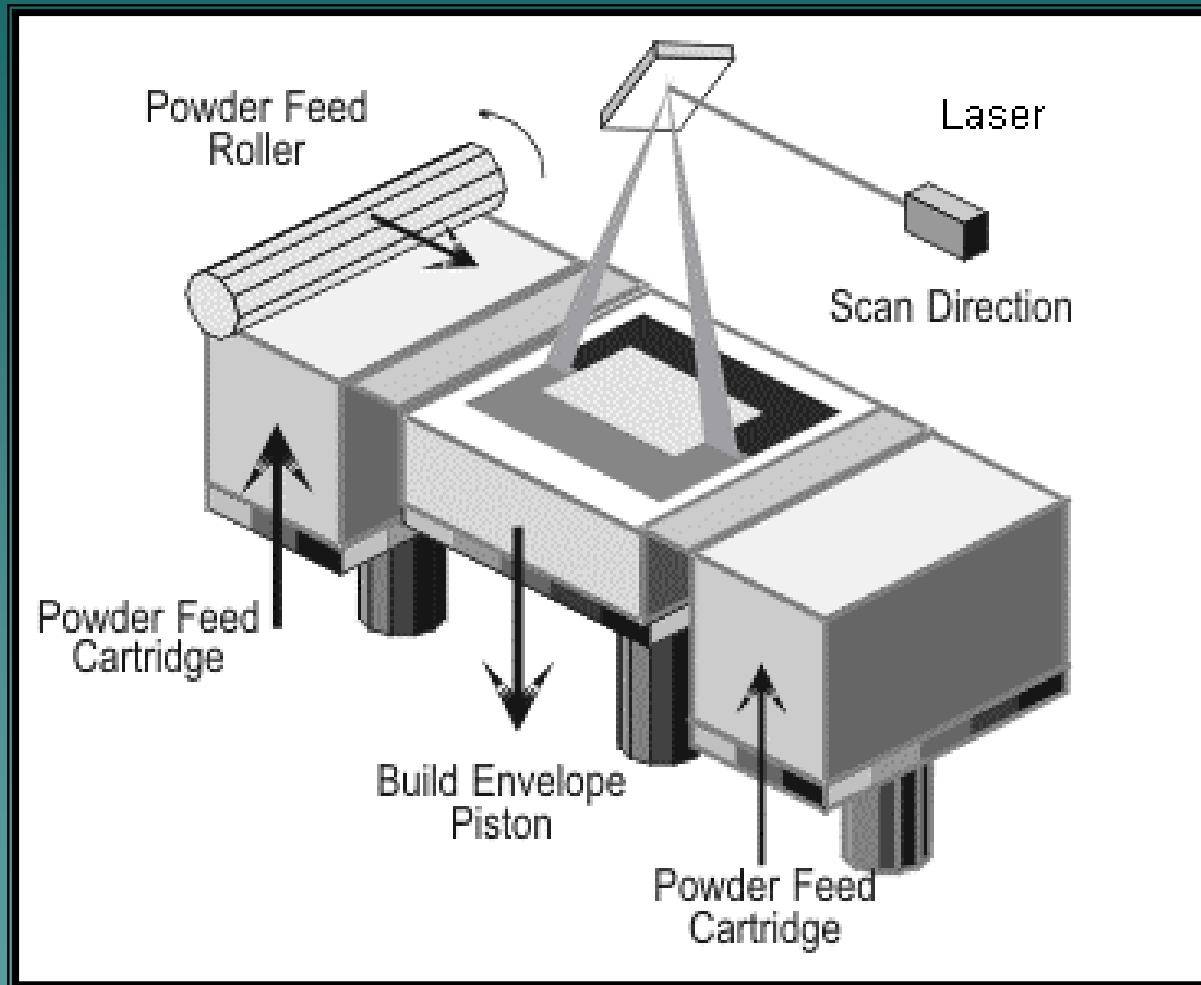
Generative Manufacturing Processes / Solid Free Form Fabrication / Rapid Prototyping



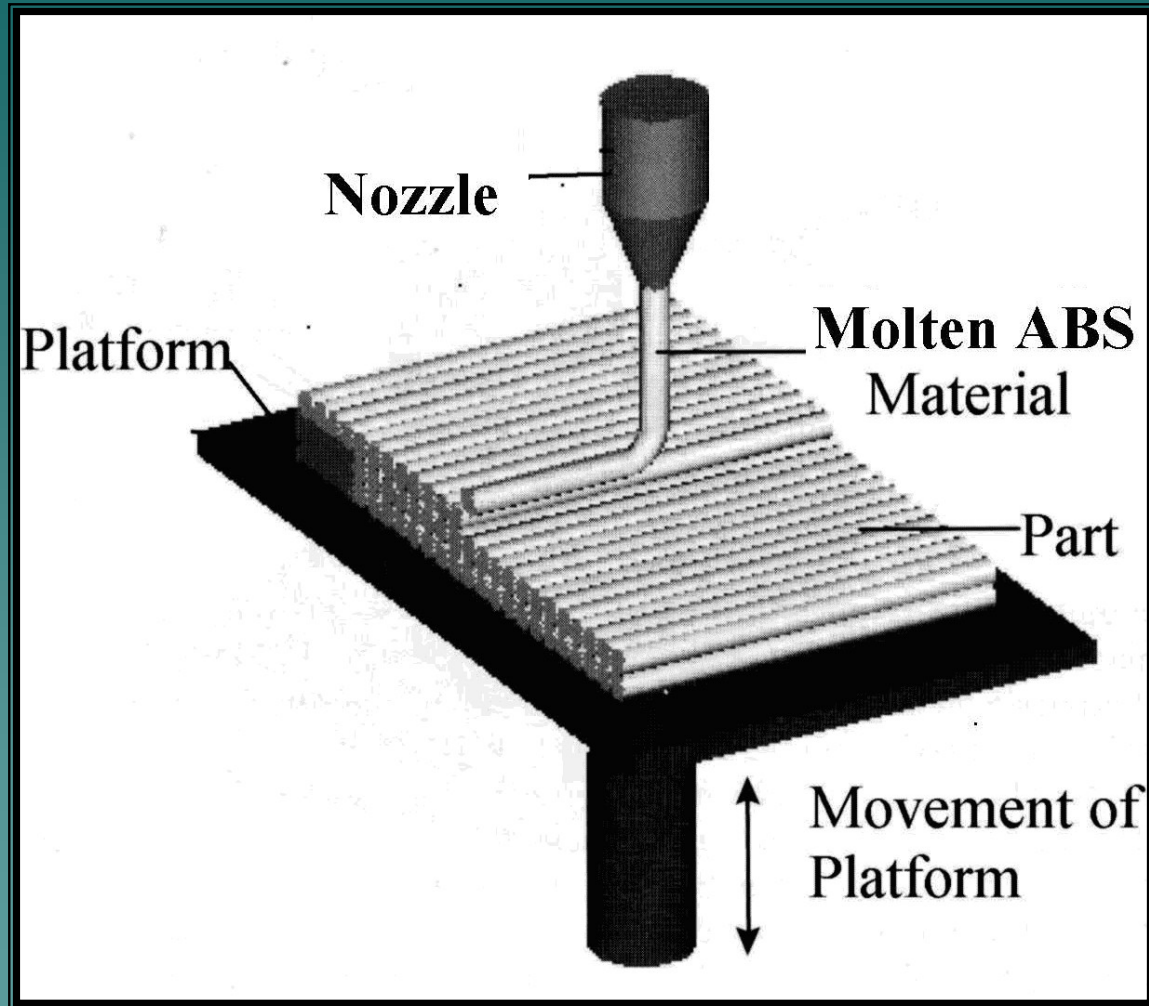
Stereolithography



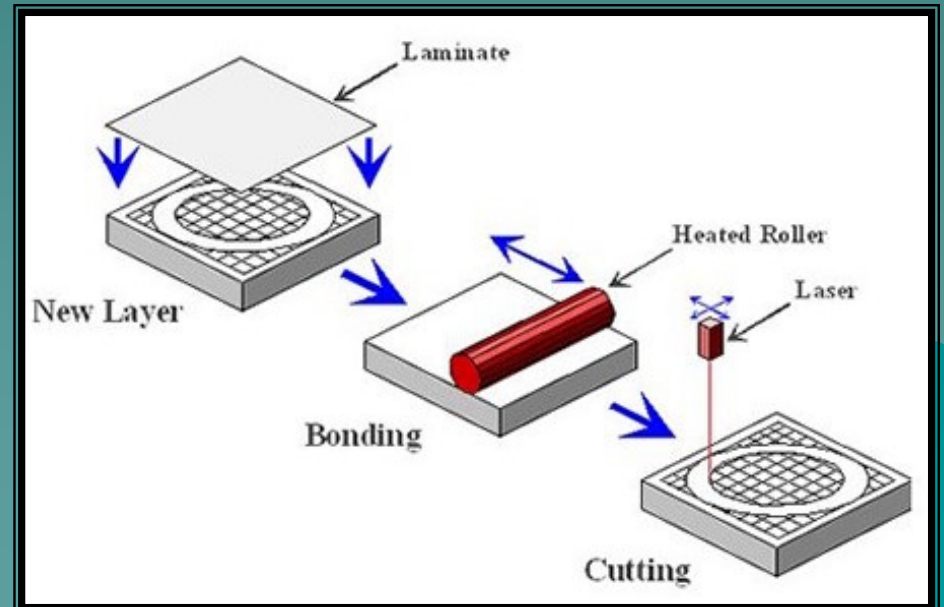
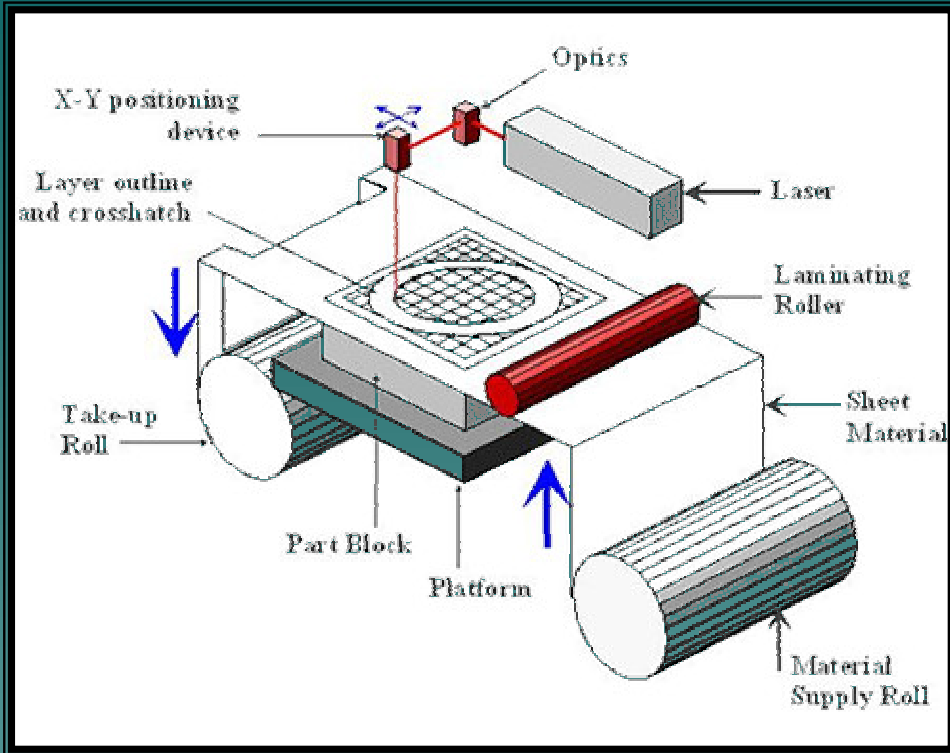
Selective Laser Sintering



Fused Deposition Modeling



Laminated Object Manufacturing



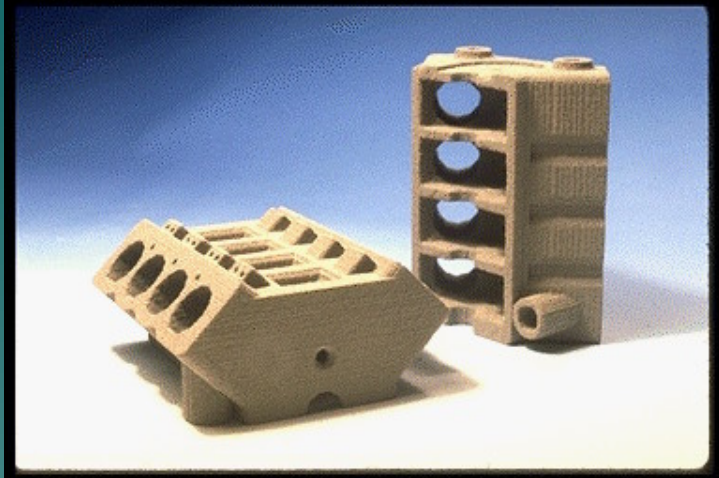
Rapid Prototyping Applications

- ◆ Design
 - CAD model Verification
 - Visualizing object
 - Proof of concept
- ◆ Engineering, Analysis and planning
 - Form and fit models
 - Flow analysis
 - Stress distribution
 - Mock-up
 - Diagnostic and surgical operation planning
 - Design and fabrication of custom prosthesis and implant

Applications

- ◆ Manufacturing and tooling
 - Plastic mold parts
 - ◆ Vacuum casting
 - ◆ Metal spraying
 - Casting
 - ◆ Sand casting
 - ◆ Investment casting
 - ◆ Die casting
 - EDM electrodes
 - Master models

RP products



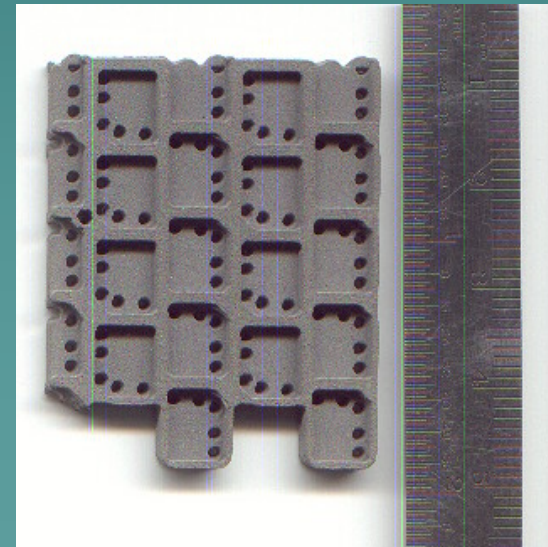
Engine Manifold



Valve

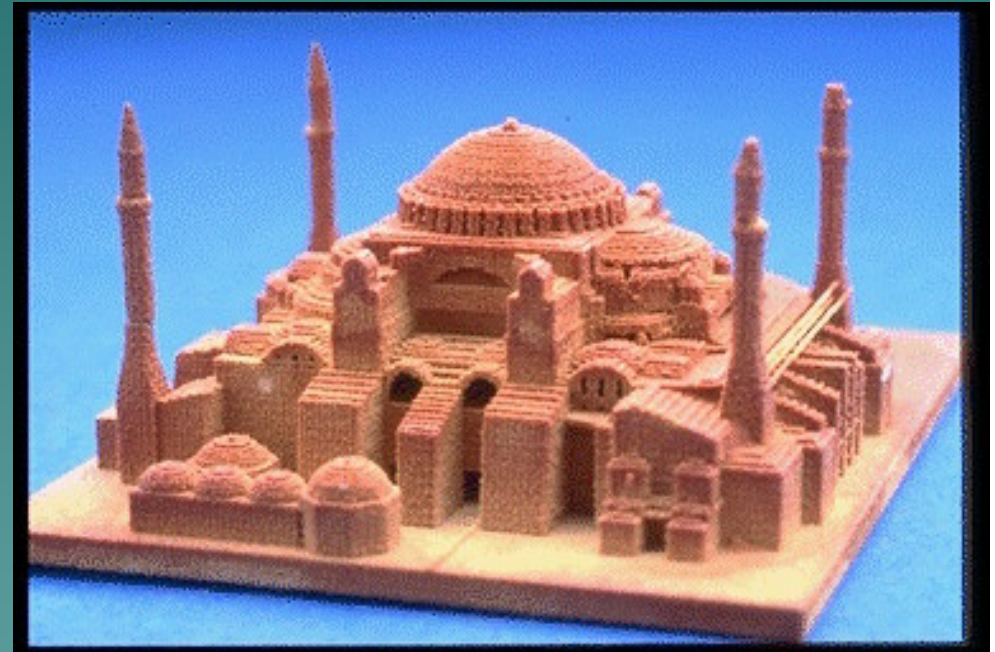
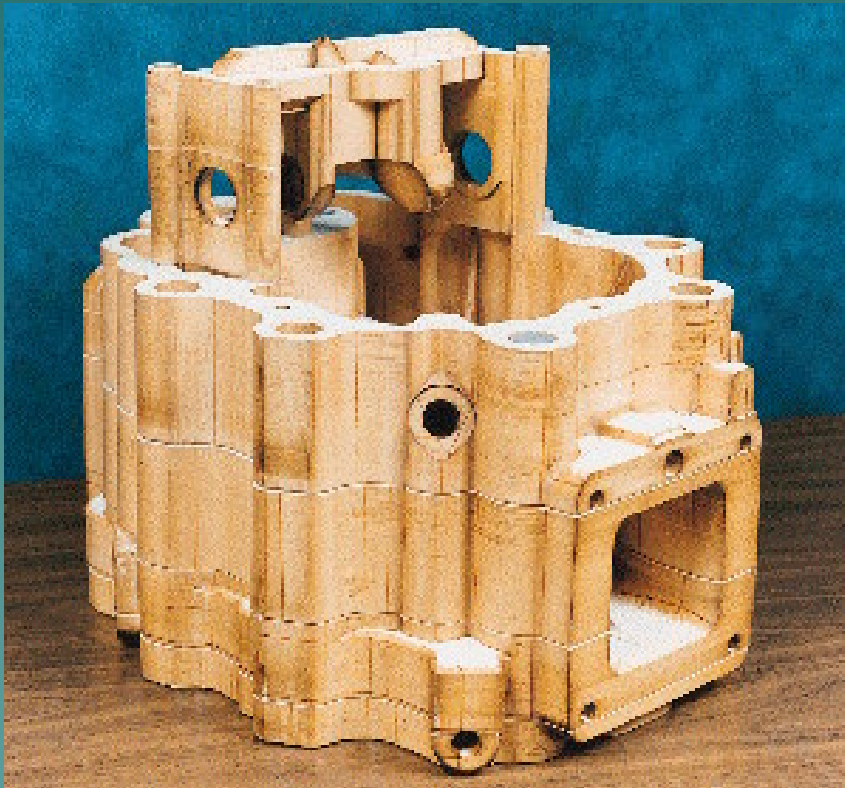


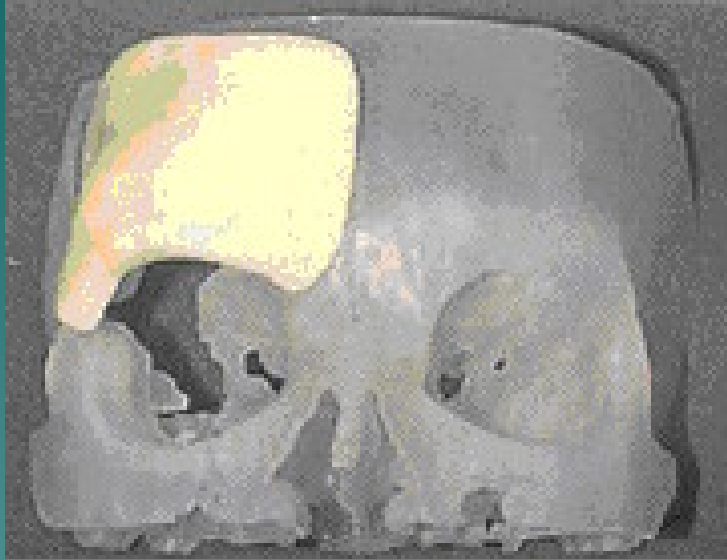
Medical Implant



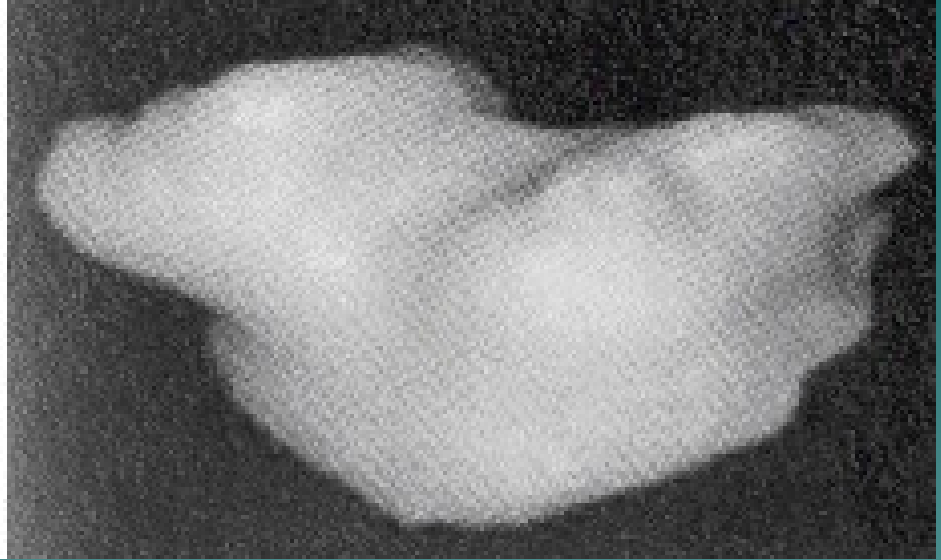
Electronic Packaging

Complexity of object to be manufactured is not a limitation in Rapid Prototyping



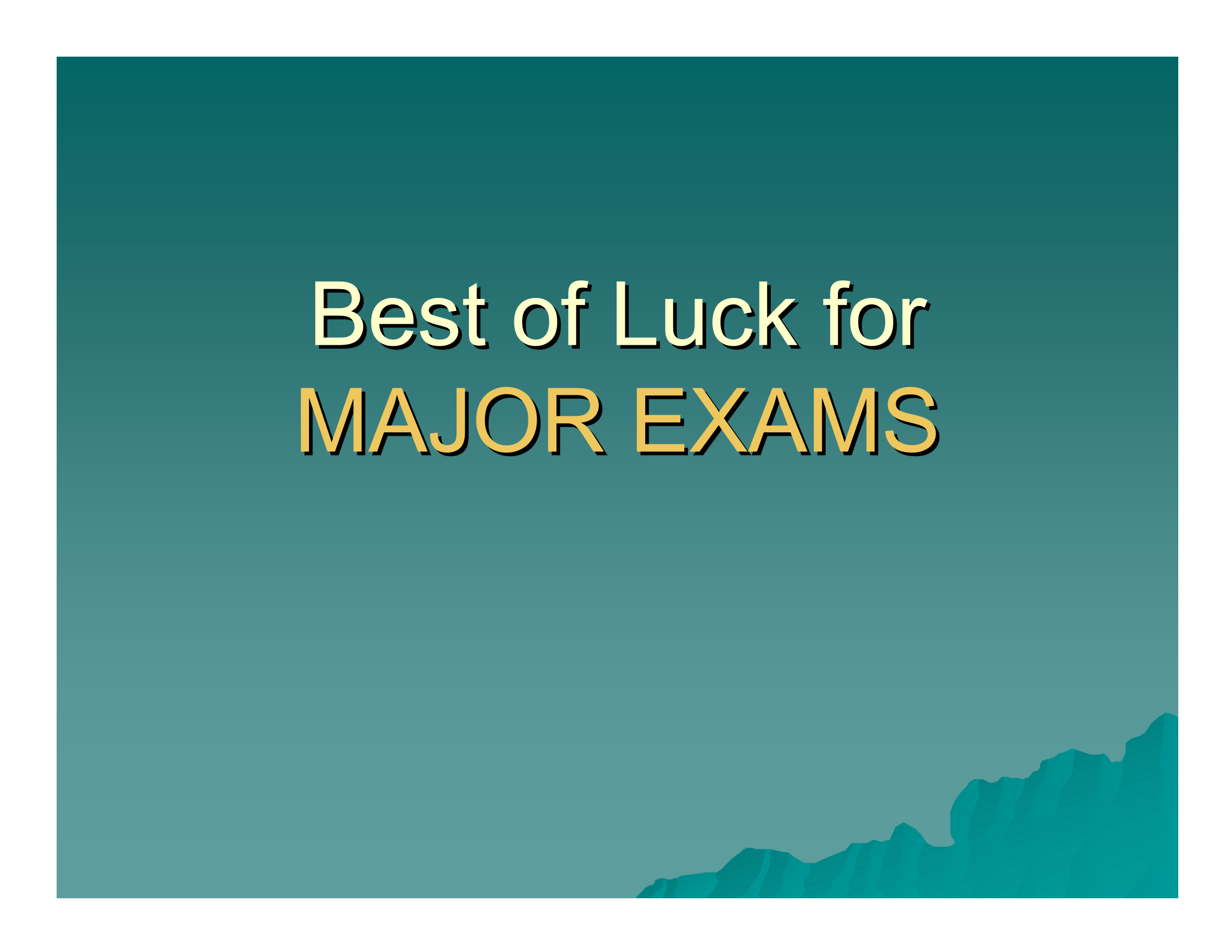


SL model with the resection template



Silicon implant molded from a tool

Best of Luck for
MAJOR EXAMS

The image features a solid teal background. In the bottom right corner, there is a stylized silhouette of a mountain range in a slightly darker shade of teal. The text "Best of Luck for" is centered in the upper half in a white, sans-serif font with a thin black outline. Below it, the words "MAJOR EXAMS" are centered in a larger, bold, yellow, sans-serif font with a thin black outline.

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