

Rapid prototyping

ME 306

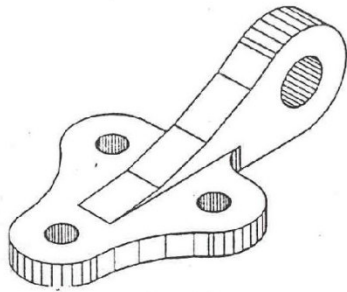
Manufacturing Technology II



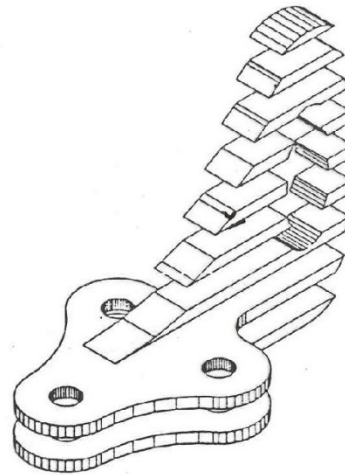
Rapid prototyping (RP)

- Building of 3 D models using 2 D cross sections
 - Layered manufacturing
 - 3-D fabrication
 - Desktop manufacturing
 - Automated fabrication
 - Tool-less manufacturing
 - Free-form fabrication
 - Time-compressed manufacturing
- Material properties and accuracy are not comparable to machining or forming operations

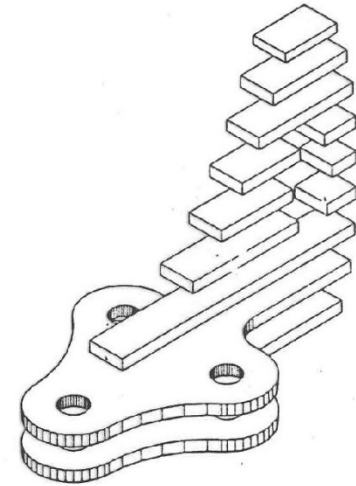
Rapid prototyping



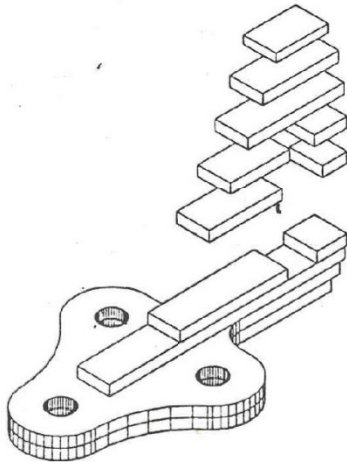
(a) CAD model



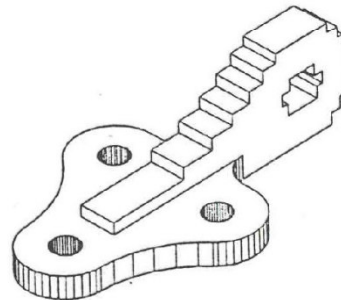
(b) Slicing the model



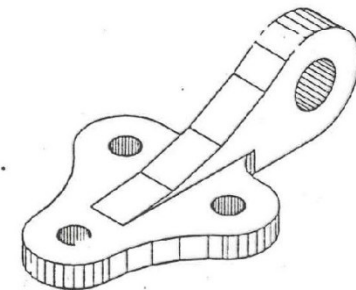
(c) Squaring edges of model



(d) Stacking and pasting layers

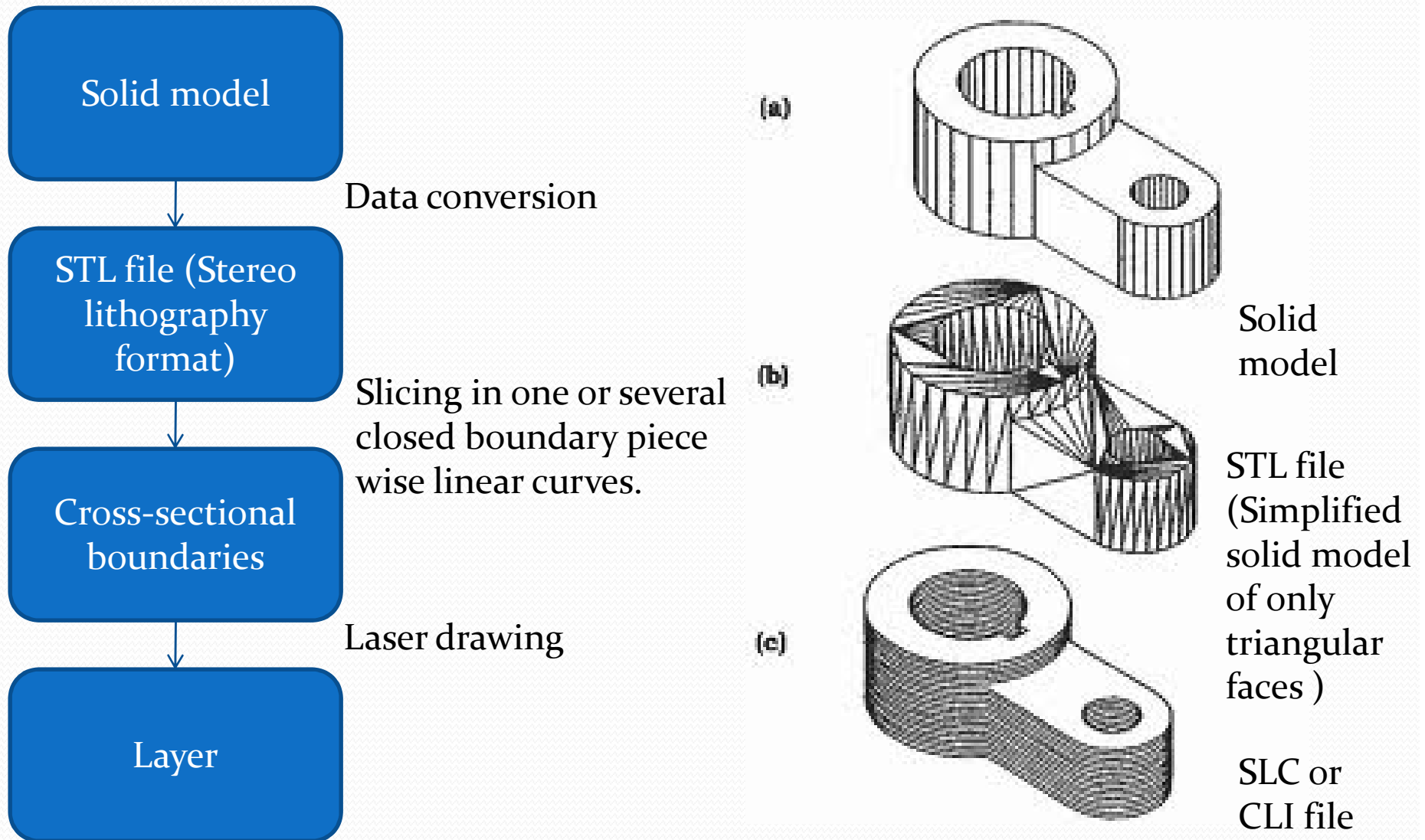


(e) Physical prototype



(f) Finished physical prototype

Method of rapid prototyping



Rapid prototyping

- Generation of Laser scanning paths or material deposition paths
- Technologies for layer deposition :
 - Liquid based: Stereo lithography
 - Powder based: Selective Laser Sintering
 - Solid based: Fused Deposition Modeling,
 - Laminated Object Manufacturing etc.
- Post curing
- Removal of support structure
- Finishing by sanding/polishing
- Painting



RP: applications

- FORM : visualization of general geometry
- FIT: dimensional accuracy
- FUNCTION: function checking

- Materials
 - Starch powder/wax
 - Epoxy, nylon or metal powder



Stereo lithography technique

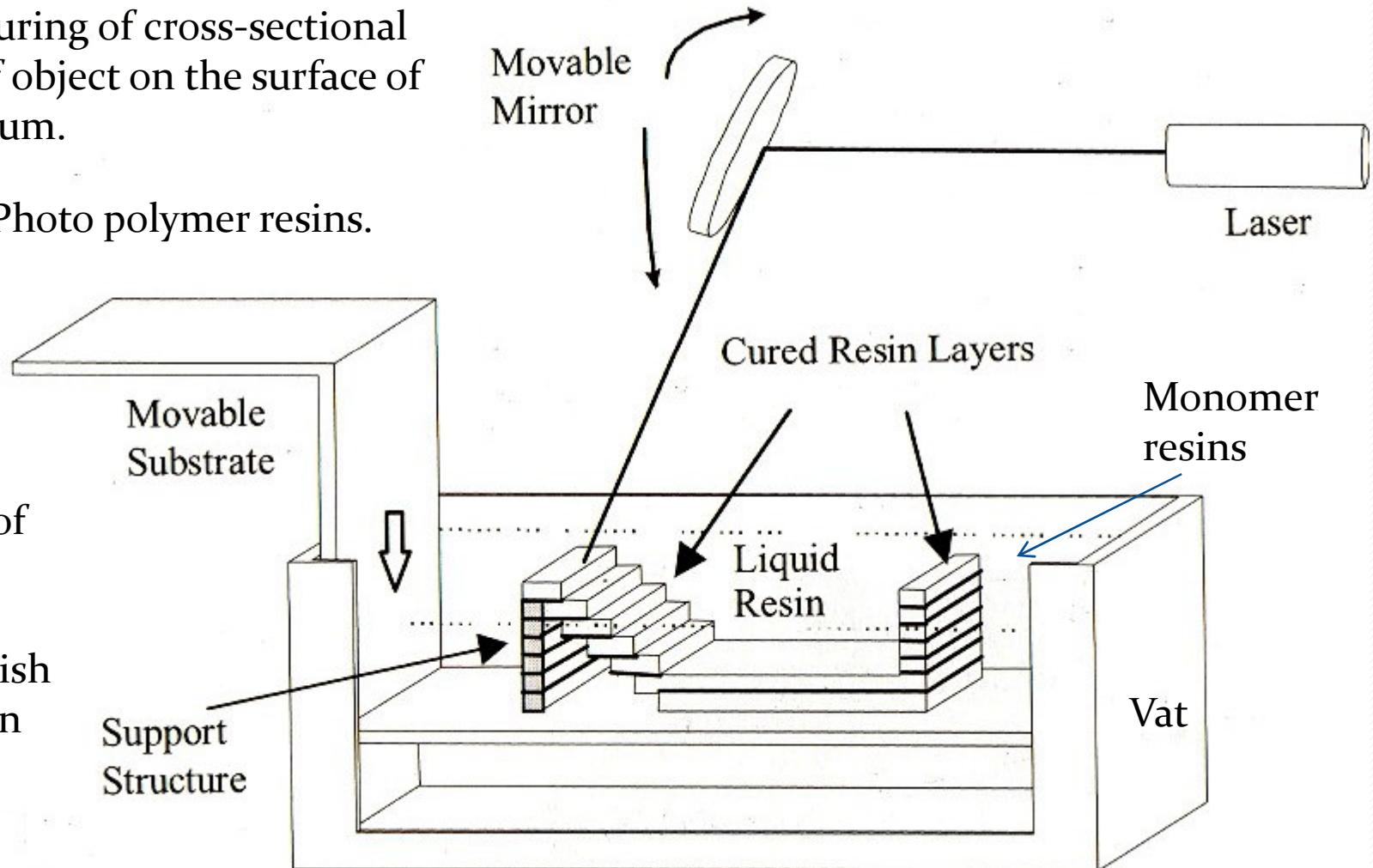
- Monomer resins -----> polymer
UV laser
- Plastics parts
- Layer by layer tracing of a UV laser beam on the surface of liquid photo-polymer
- Quick solidification; self adhesive property

Stereo lithography, Charles Hull 1982

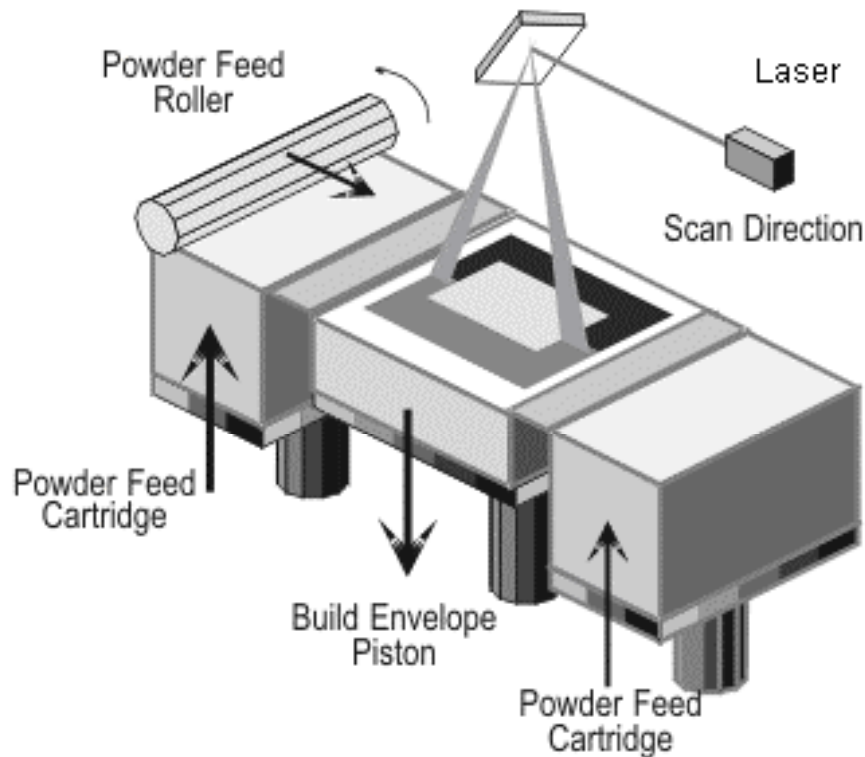
Selective curing of cross-sectional patterns of object on the surface of fluid medium.

Curing of Photo polymer resins.

Accuracy of
 ± 0.005 to
 ± 0.01 in
Surface finish
200-300 μin



Selective Laser sintering



Thermo-plastic materials: Nylon, glass filled nylon, Thermo-plastic elastomer, polyamide, and polystyrene, plastic coated metal/ceramic powder.

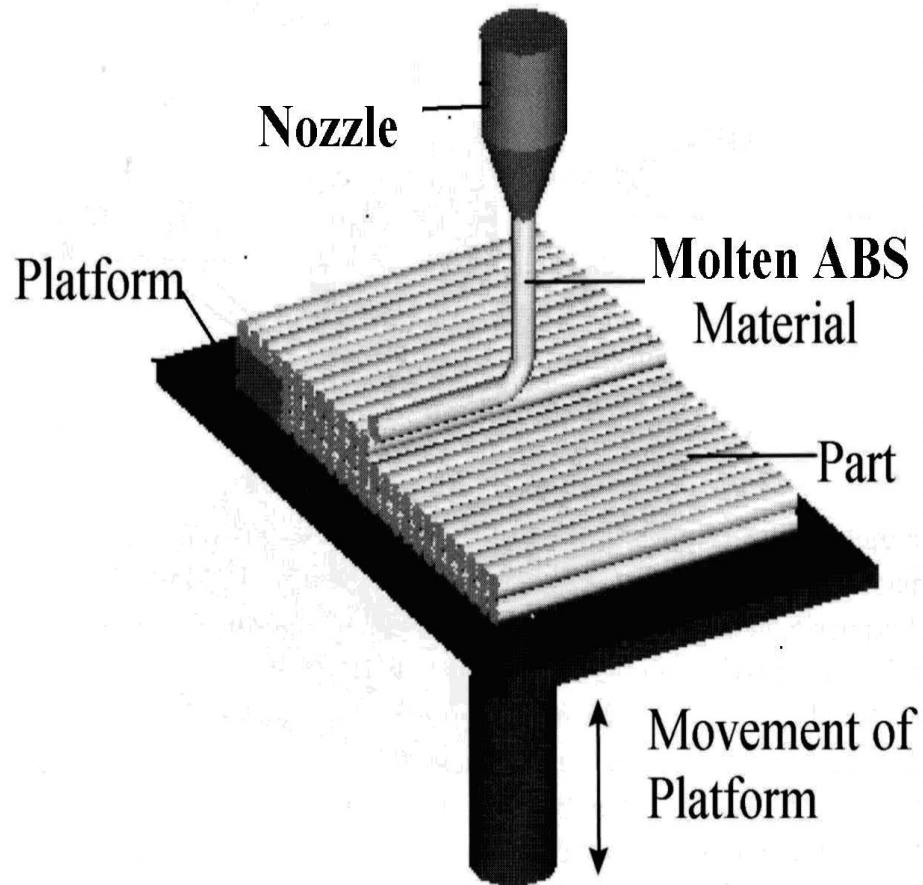
Melting of thermo-plastic powder by using Laser beams

No need of supportive structures for overhangs and undecuts

More powerful lasers

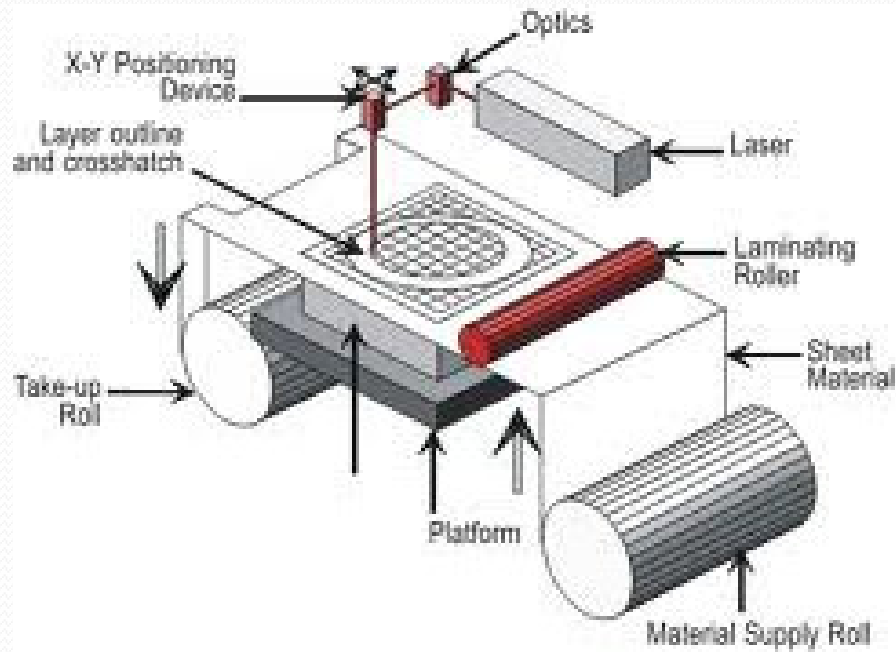
Accuracy of ± 0.005 to ± 0.01 in
Surface finish 300-400 μin

Fused deposition modeling

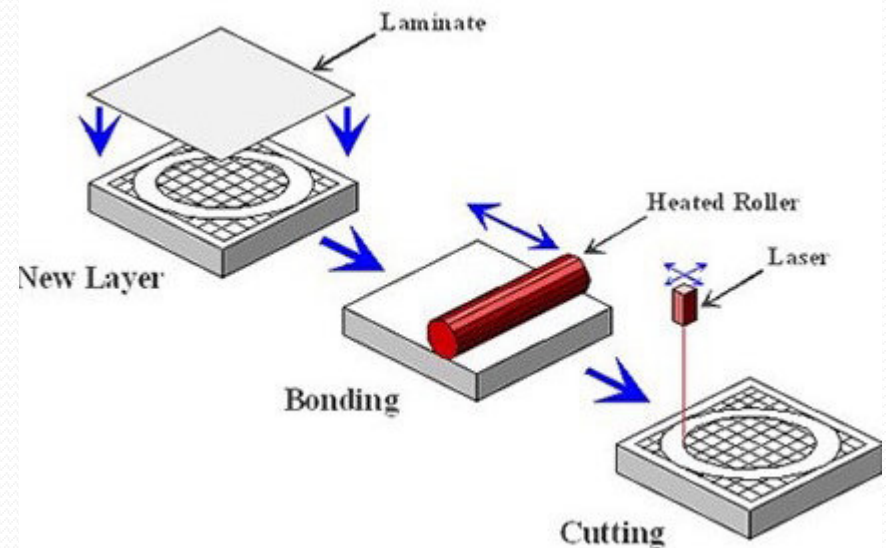


- Second most widely used technique
- Material : Acrylonitrile-butadienestyrene (ABS) + simple wax : provides good strength
- Suitable small parts
- Accuracy is \pm about 0.001"

Laminated object manufacturing



- Material cost is very low
- Accuracy $\pm 0.015''$
- Stability of paper objects
- Mainly used for pattern making in sand castings





Applications of RP

- 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 implants



Applications of RP

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



All the best
for the end semester examination !