Rapid prototyping

CAD / lecture
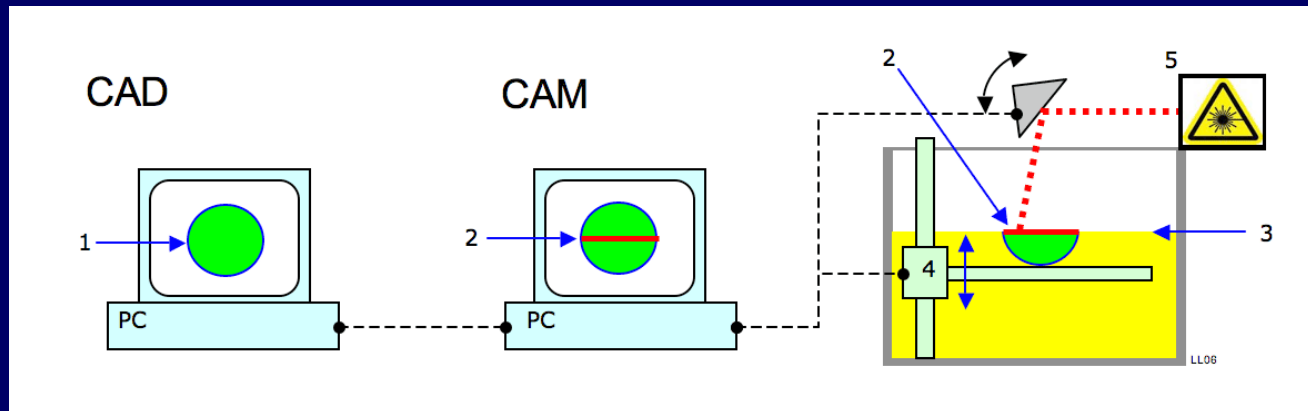
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Rapid prototyping

Rapid prototyping is:

• **Rapid prototyping is an additive (layered) digital fabrication technology**
• **Layers of material are added forming the final 3d physical model**
• **The digital data of the virtual 3d model is divided in slices and manufactured in layers**
• **They differ from other digital manufacturing techniques like milling and laser cutting which are subtractive in nature**

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Rapid prototyping

Main types of Rapid prototyping are:

• **Selective laser sintering (SLS) - Laser fuses plastic, metal or ceramic particles together.**
• **Fused Deposition modelling (FDM) - Plastics or metal are melted and used as printfluid.**
• **Stereo lithography (STL or SLA) - Laser cures the "fluid resin" in layers.**
• **Laminated object manufacturing (LOM) - Layers of paper or plastic are cut and stacked.**
• **3D Printing (3DP) - Layers of powder are bound together by fluid from printerhead.**

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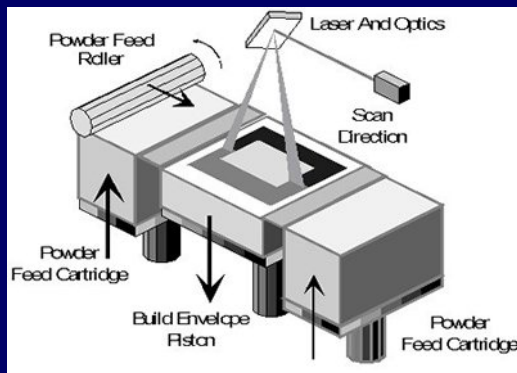**Delft University of Technology**

Rapid prototyping

Main types of Rapid prototyping are:

Selective laser sintering (SLS) Laser fuses plastic, metal or ceramic particles together.
• Advantage a wide range of materials can be used.
• Disadvantage the accuracy is depending on the particle size.

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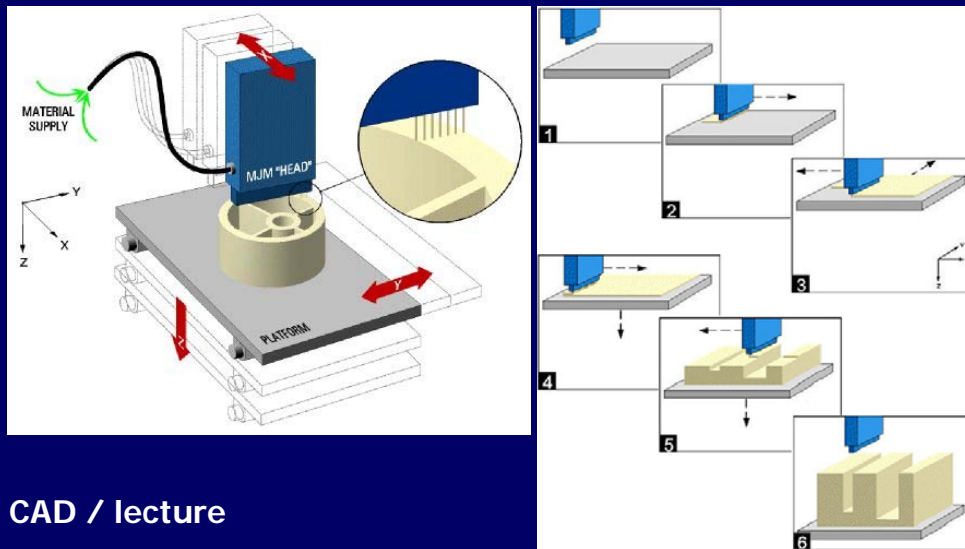
Rapid prototyping

Main types of Rapid prototyping are:

Fused Deposition modelling (FDM) Plastics or metal are melted and used as print fluid for layered printing.
• **Advantage is that several materials can be used with different strength and melting temperature.**
• **Disadvantage is the limited detail in the printing process.**
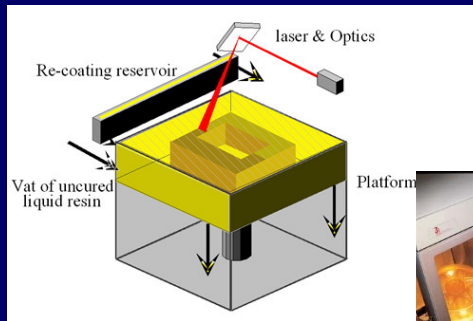

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Rapid prototyping

Main types of Rapid prototyping are:

Stereo lithography (STL or SLA) Laser cures the liquid photopolymer in layers.
• Advantage is the high accuracy of the models.
• Disadvantage is the high machine costs and the limited amount of materials which can be used.


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Rapid prototyping

Main types of Rapid prototyping are:

Laminated object manufacturing (LOM) Layers of paper or plastic are cut and stacked.
• Advantage is the low costs of material and the large size of the object.
• Disadvantage are the limited amount of materials which can be used.

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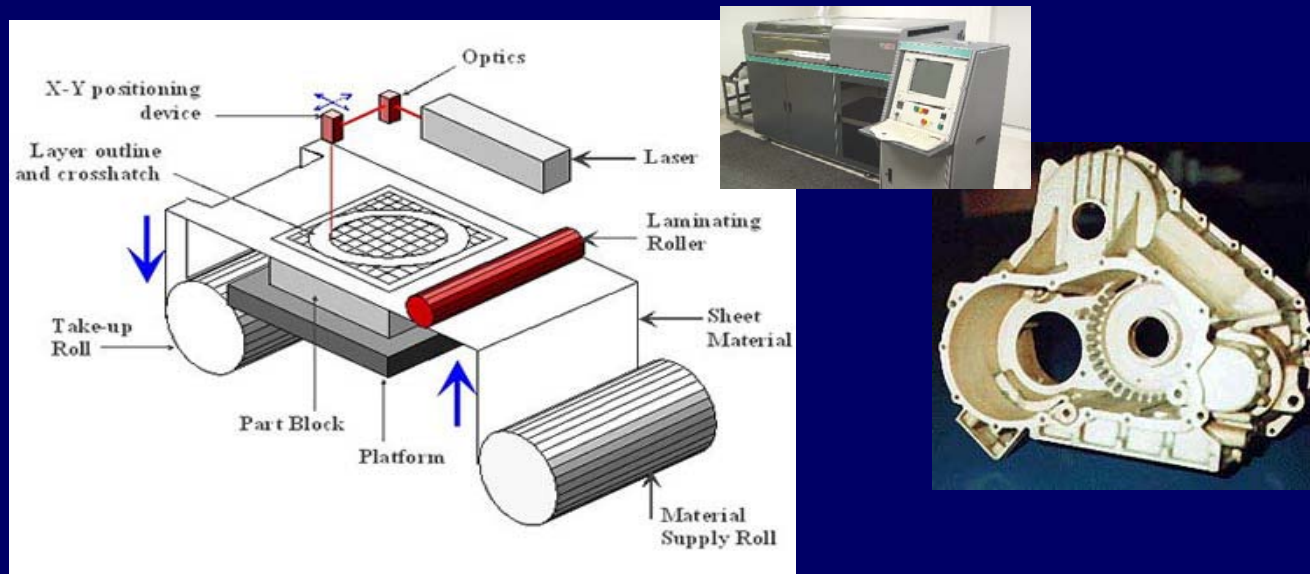
Rapid prototyping

Main types of Rapid prototyping are:

3D Printing (3DP) Layers of powder are bound together by fluid from printer head.
• Advantage is the low costs , ease of use and speed of the printing process.
• Disadvantage are the limited amount of materials which can be used and the limited accuracy.

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Rapid prototyping

Main types of rapid prototyping difference:

Used material:

*Strength of the 3D model
*Accuracy of the 3D model
*Surface finish of the 3D model
*Cost per print

Machines:

*Cost
*Size of the machine
*Hazardous environment?
*Speed
*Size of object

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Rapid prototyping

The use of rapid prototyping techniques:

• Design support
• Basis for indirect manufacturing
• Direct manufacturing (low volume)

Advantages are:

• The speed of making physical models in comparison with the traditional model making techniques.
• The possible complexity of the models
• The direct link with the digital design data
• Testing design concepts or functionality of the object
• Possibility of using the 3D models as a mould or a contra mould
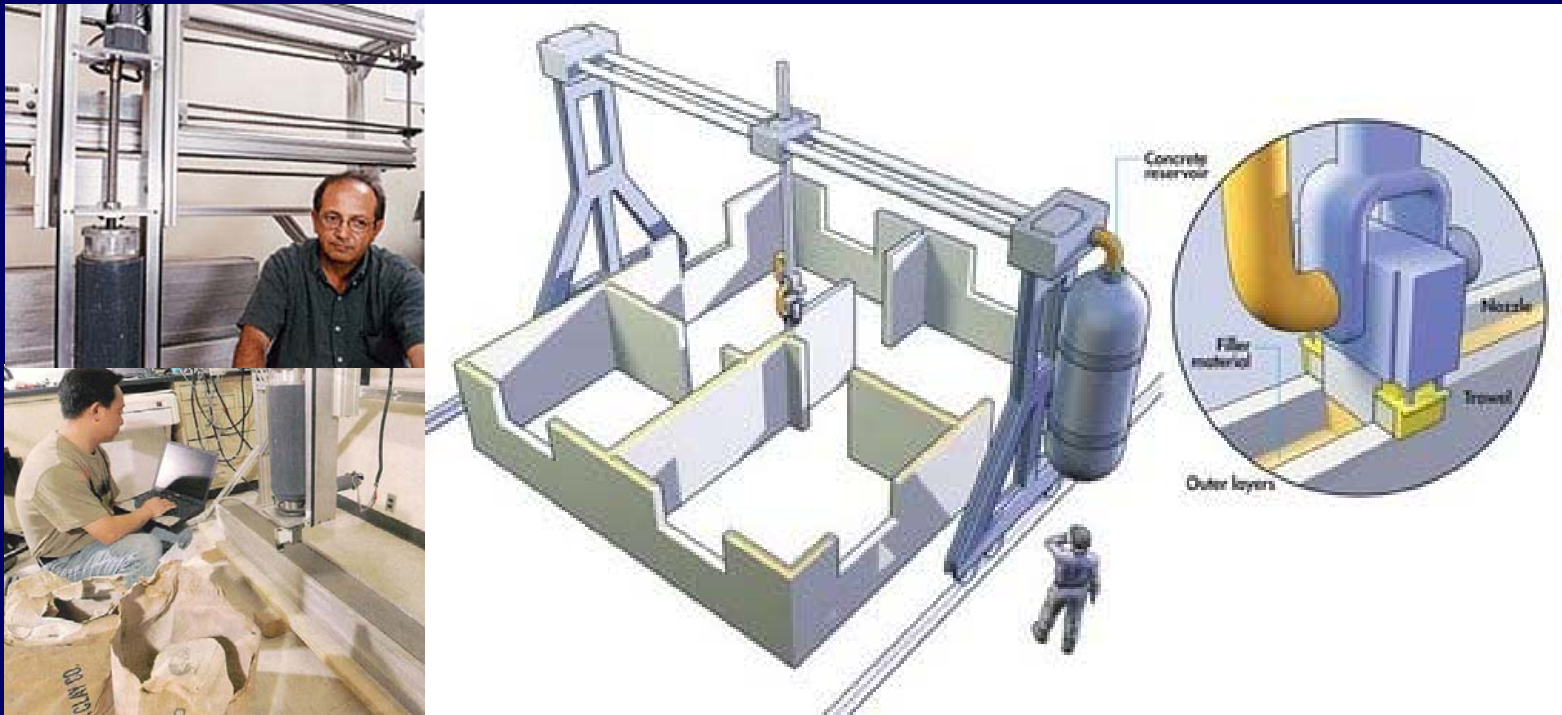• Direct manufacturing of low volumes

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Rapid prototyping

3D printing – contour crafting
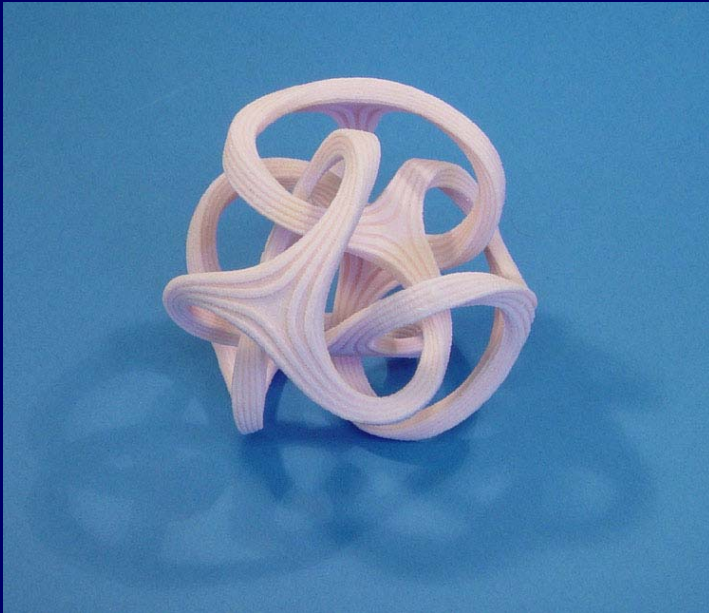
Large scale3d printing
Behrokh Khoshnevis is a professor of *Industrial & Systems Engineering* **and** *Civil & Environmental Engineering USC*

Rapid prototyping

The use of rapid prototyping techniques: Design support

Visual feedback

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Rapid prototyping

The use of rapid prototyping techniques: Design support

3D model of the design - Communication

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Rapid prototyping

The use of rapid prototyping techniques: Design support

Prototyping a construction detail - analysis

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Rapid prototyping

The use of rapid prototyping techniques: Basis for indirect manufacturing

Rapid prototyping of casts – low volume production

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Rapid prototyping

The use of rapid prototyping techniques: Basis for indirect manufacturing

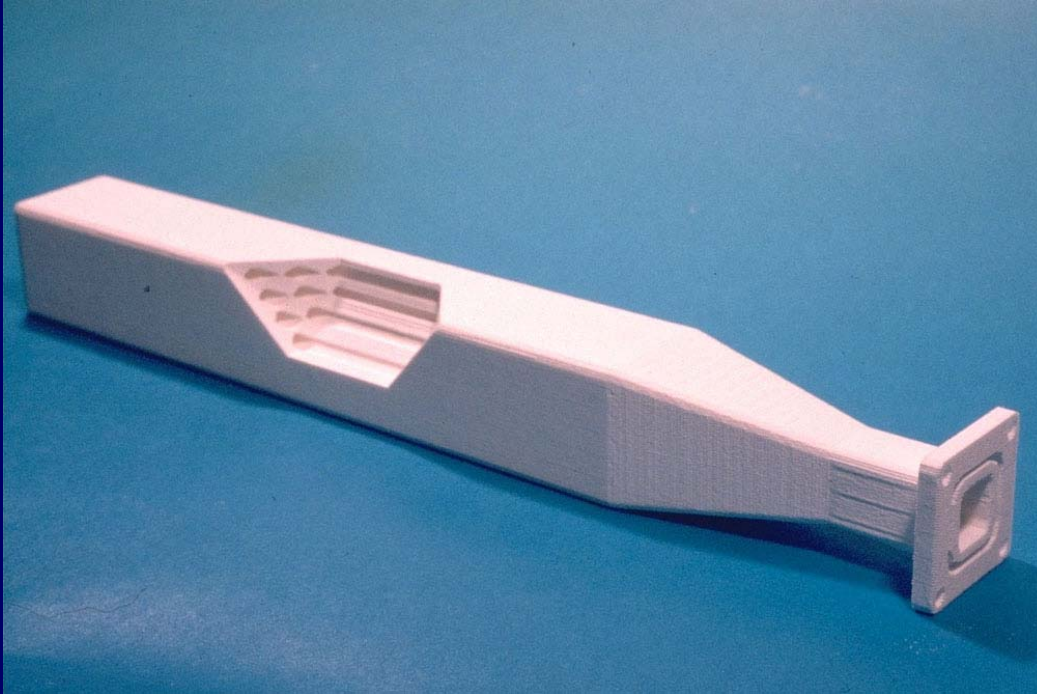**Rapid prototyping of contra moulds**

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Rapid prototyping

The use of rapid prototyping techniques: Direct manufacturing

3D printed CO2 filter for power plant

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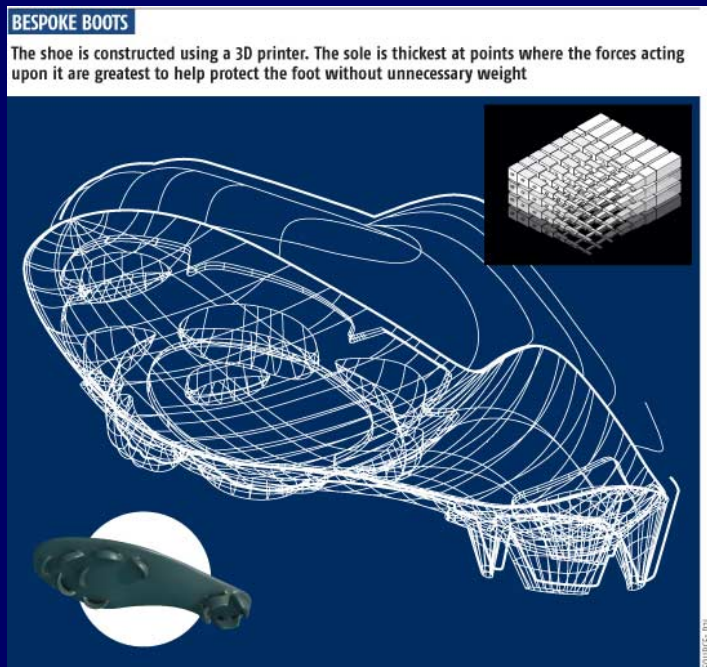
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Rapid prototyping

The use of rapid prototyping techniques: Direct manufacturing

3D printed soles of customized shoes for Olympic athletes

BESPOKE BOOTS

The shoe is constructed using a 3D printer. The sole is thickest at points where the forces acting upon it are greatest to help protect the foot without unnecessary weight

SOURCE: PZL

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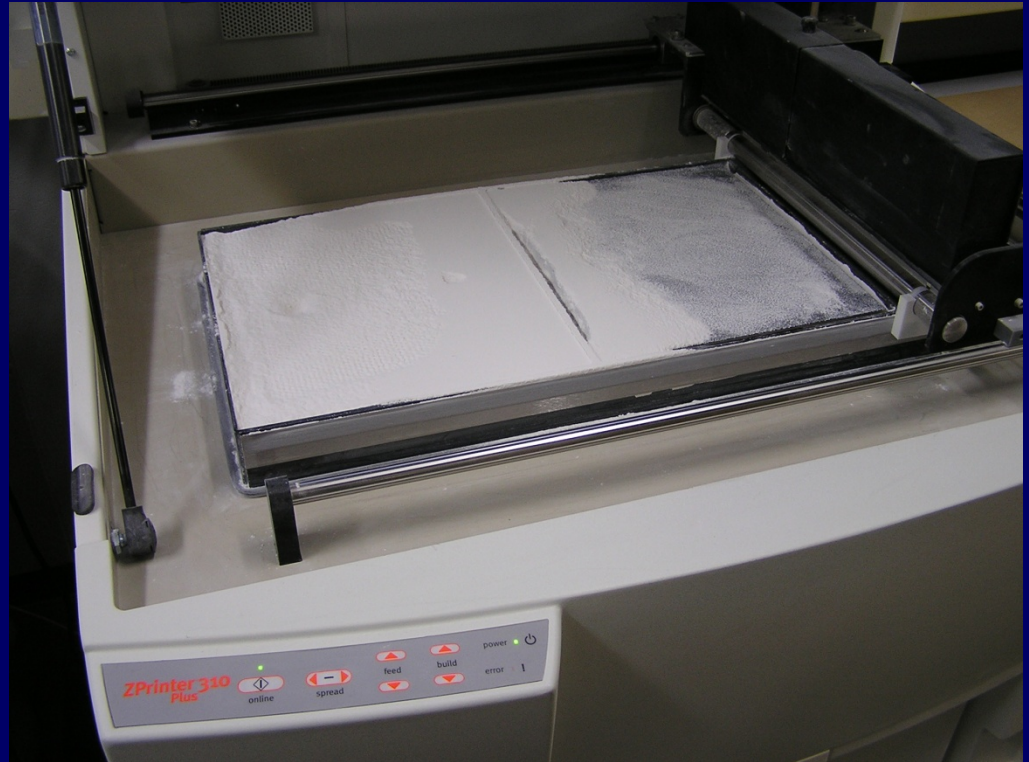
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Rapid prototyping

3D printing at the faculty

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Rapid prototyping

3D printing at the faculty

The Cam Lab has two 3D printers for students to use.
The printers generates gypsum plaster models

Z Corp 350 3D printer
The maximum sizes for the models are:
20,3 x 25,4 x 20,3 cm (8 x 10 x 8 inch)

Z Corp 510 color 3D printer
The maximum sizes for the models are:
25,4 x 35,6 x 20,3 cm (10 x 14 x 8 inch)

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Rapid prototyping

3D printing at the faculty

The printers generates gypsum plaster models

The material is quite brittle and not suitable for supporting high loads

The accuracy is 0.1 mm

Minimum thickness of 3 mm for walls and floors
Minimum thickness of 1 mm for columns (thicker when higher)
Minimum thickness of 3 mm for free-standing columns
Embossments are already visible with only 0.1 mm difference

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Rapid prototyping

3D printing at the faculty

Software:

CAD (Maya-Rhino) – design of the 3D model
CAM (Zprint) – print software imports the 3D model and prints the imported 3D model

The Zprint software imports files with extension of VRML or STL
The 3D model has to be a closed 3D polygon model for printing

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