



FTC CAD/3D Printing

INTRO TO COMPUTER AIDED DESIGN

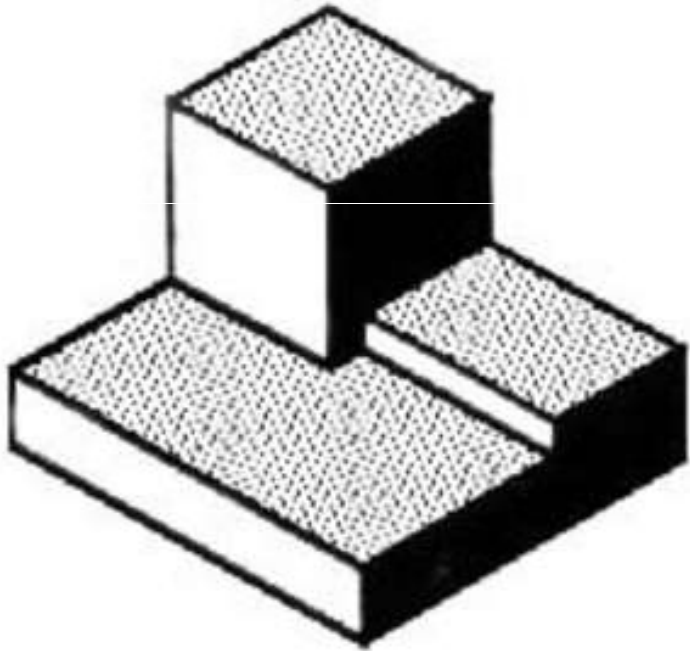
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Make the object I describe.
(This is all the info you will get!)

- ▶ Make a square shaped flat plate.
- ▶ Make a cube about $\frac{1}{4}$ the dimensions of the flat plate.
- ▶ Put the cube on top of the plate.
- ▶ Make a second plate with:
 - ▶ Width slightly greater than the cube.
 - ▶ Length slightly less than the cube.
- ▶ Place the second plate on top of the first plate.
- ▶ Show off the result!

I have an object....

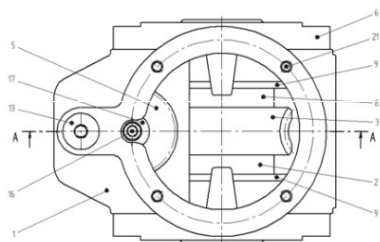
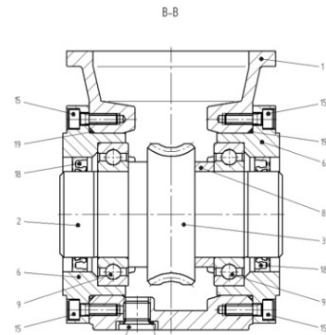
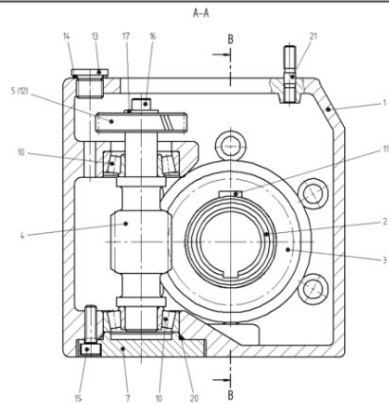


What info is important to describe this machined block?

- Dimensions
- Materials
- Finish (ie: polished, rough,...)
- Coloring
- Special instructions (welding, glue,...)

Figure 1 - A Machined Block.

Drawing vs. model



Pos.	Menge	Zeichen	Benennung	Zeichener / Name	Kurzbeschreibung	Bemerkung
1	1	Stück	Gehäuse			IS - AUSDRUK
2	1	Stück	Nutzwelle			34CMMK
3	1	Stück	Schneckenrad			IS - C60G2N6
4	1	Stück	Schneckenwelle			18M6C/S
5	1	Stück	Zahnrad			18M6C/S
6	2	Stück	Lagerdeckel groß			1235LR
7	1	Stück	Lagerdeckel klein			1235LR
8	1	Stück	Driftantrieb			1235LR
9	2	Stück	Rollenlagerlager		DN 625 - 6009	
10	2	Stück	Keilriemenlager		DN 720 - 30203	
11	1	Stück	Passfeder groß		DN 685 - B 12 x 8 x 22	
12	1	Stück	Passfeder klein		DN 685 - B 5 x 5 x 10	
13	2	Stück	Verschraubung		DN 108 - M16 x 15 - 51	
14	2	Stück	Dichtungsring		DN 7603 - A 16 x 18 V1	
15	15	Stück	Zylinderschraube mit Innenschraube		IS 4762 - M6 x 20 - 6.6	
16	1	Stück	Zylinderschraube mit Innenschraube		IS 4762 - M6 x 16 - 6.6	
17	1	Stück	Sechskant		DN 1021 - B 6.6	
18	2	Stück	Rollen-Wellenring		DN 1760 - 45 x 15 x 8	
19	2	Stück	Ölring		DN 1771-45x15-16-N60-70	
20	1	Stück	Ölring		DN 1771-45x15-16-N60-70	
21	4	Stück	Stiftschraube		Kaufteil gemäß Zeichnung	1235LR

Schneckengetriebe



CAD Software

Commercial (market leaders)

- Autodesk AutoCAD
- Autodesk Inventor
- Dassault CATIA
- Dassault SolidWorks
- Kubotek KeyCreator
- Siemens NX
- Siemens Solid Edge
- PTC Pro/ENGINEER (now renamed Creo)

Commercial (other)

- IronCAD
- Medusa
- ProgeCAD
- SpaceClaim
- Rhinoceros 3D
- VariCAD
- VectorWorks
- Cobalt

- Onshape (cloud-based CAD)

Free and open source

- 123D
- LibreCAD
- FreeCAD
- BRL-CAD
- OpenSCAD
- NanoCAD
- QCad
- OnShape

CAD Kernels

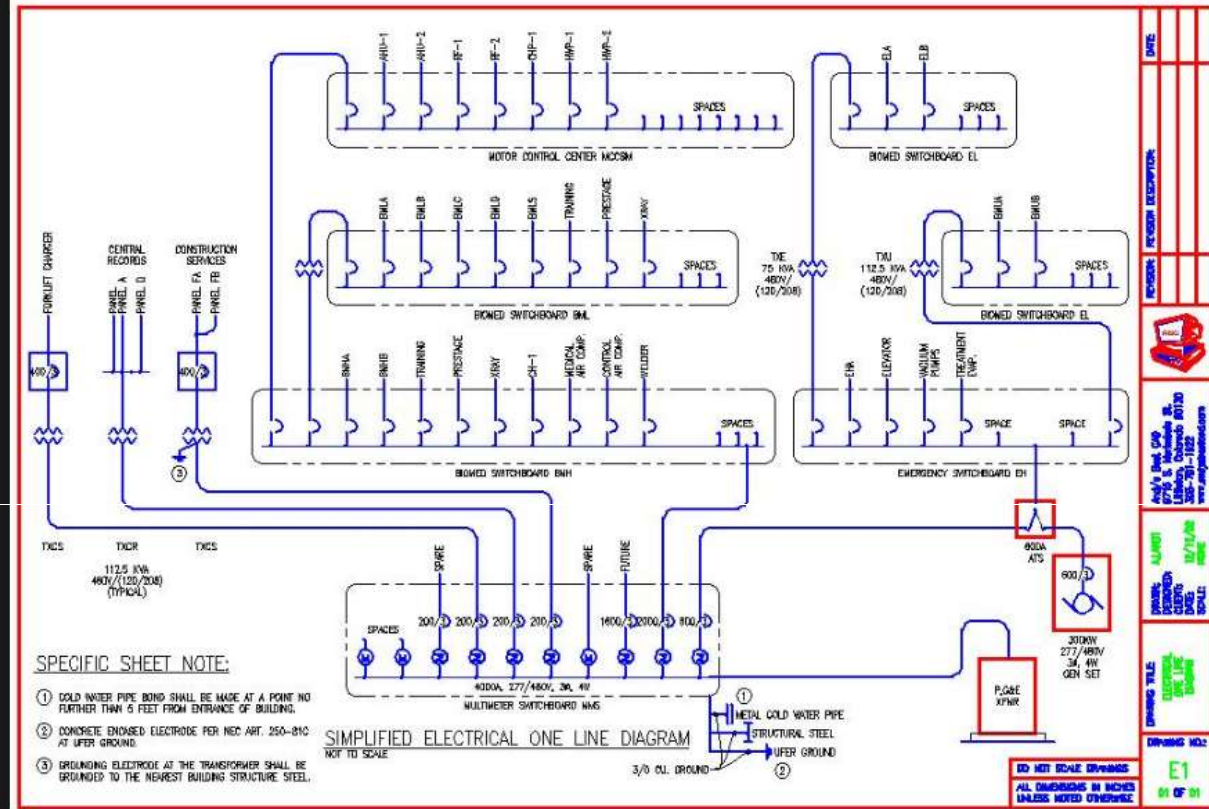
- Parasolid by Siemens
- ACIS by Spatial
- KCM by Kubotek
- ShapeManager by Autodesk
- Open CASCADE
- C3D by C3D Labs

FTC CAD – Computer Aided Design

- ▶ Three good options
 - ▶ Autodesk Fusion 360
 - ▶ <https://www.autodesk.com/products/fusion-360/overview>
 - ▶ PTC Creo – official sponsor of FTC.
 - ▶ <http://www.ptc.com/academic-program/products/free-software>
 - ▶ PTC gives grants to some teams demonstrating Creo use in prior seasons.
 - ▶ Autodesk Inventor
 - ▶ <http://www.autodesk.com/education/free-software/inventor-professional>
 - ▶ LOTS of free on-line training resources (ie: YouTube, etc.) both from Autodesk and teachers/professors.
- ▶ Great addition to your FTC engineering notebook.
- ▶ CAD models can be downloaded to a 3d printer for a custom created part.

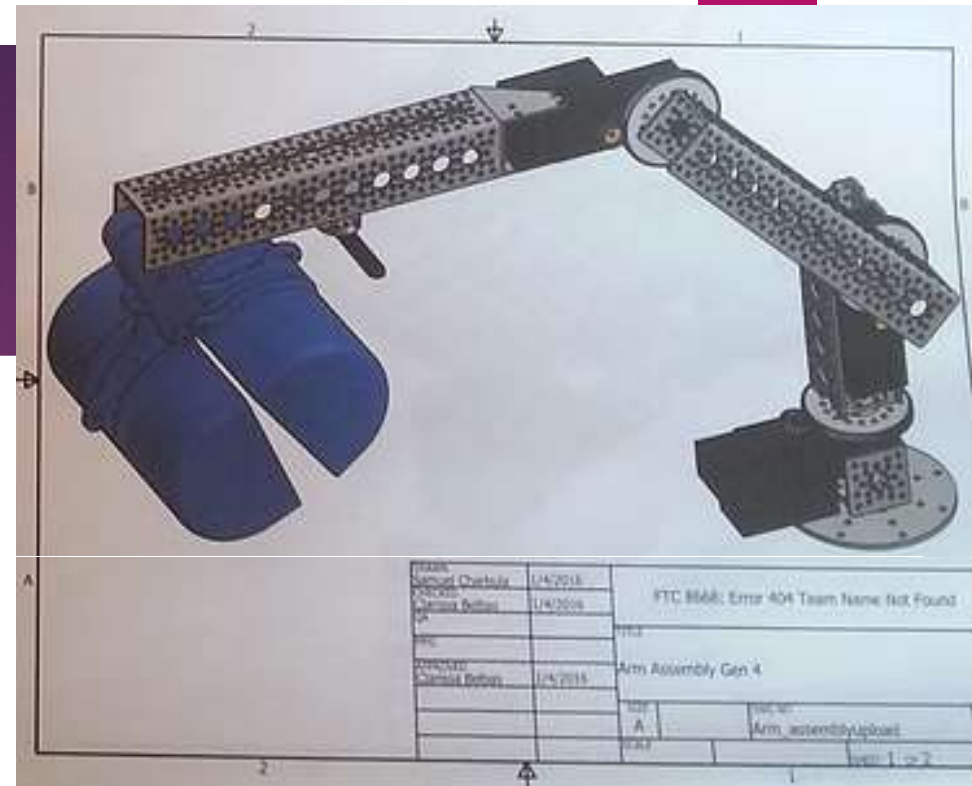
Autodesk AutoCAD

- ▶ AutoCAD – 2 dimensional drawings
 - ▶ “Jack of all trades” – mechanical, piping, electrical, etc.
 - ▶ Lots of functionality – but can be difficult to find what you want amidst the complexity (unless you are a super user)



Autodesk Inventor

- ▶ Inventor – 3 dimensional models
 - ▶ Very focused on mechanical design. So very easy to create 3D mechanical models.
 - ▶ Not so great for other functions such as electrical schematics, etc.
 - ▶ Can animate your creations with simple motions to simulate the functionality.
 - ▶ Can “render” the materials so they look more realistic – almost like a photo.





Autodesk – other packages

- ▶ Fusion 360 – cloud based collaboration – create/modify your model in an on-line environment
- ▶ A360 – cloud based collaboration – view, share, comment online. Available as an app for your phone or device to view drawings, models, etc.

Links

- ▶ PTC Download - <http://www.ptc.com/academic-program/products/free-software>
- ▶ FIRST Blog – Team used PTC Creo to 3d print tank tread - <http://firsttechchallenge.blogspot.com/p/3d-printing-for-first-teams-from-ptc.html>
- ▶ <http://www.autodesk.com/education/free-software/inventor-professional>

Goals for this workshop

- ▶ Introduction to Autodesk Inventor and 3D printing.
 - ▶ Create a simple 3d part (keychain)
 - ▶ Download and prep the part for printing on a 3d printer. Begin the print.
 - ▶ Create a more complicated 3D part (gusset).
 - ▶ Create an even more complicated 3D part.
 - ▶ Making engineering drawings from your model.
 - ▶ Connecting parts to make an assembly. (FTC CAD kit of parts).
 - ▶ Assemble the simple FTC pushbot chassis or your robot “wannabe”.
 - ▶ Maybe Wed morning: 3d printing – examples, tips, and tidbits