Alpena Community College
Bob Tosch Cad/Cam CNC
MFG/IND Engineering
Cad/Cam CNC

• Instructor - Robert Tosch Ext. 7421

• Objectives
  – Careers/training opportunities
  – Safety/PPE
  – Speeds & feeds
  – Precision inspection
  – Projects

• Lunch

• Shop tours

• Guest speakers
Career Outlook CAD/CAM & CNC

• Job growth (2012-2022)
  – Source: Michigan Bureau of Labor Market Information
• CAD/Mechanical Designer = 0%
• CNC Set-Up/Machinist = +26%
• CNC Programmer = +38%
• Inspection/Quality Assurance = +15%
• Machinist = +17%
• Tool Makers = +11%
• Welders = +10%
Skill / Knowledge for this career

- **Skills**
  - Programming
  - Complex Problem Solving
  - Critical Thinking
  - Equipment Monitoring
  - Operation Monitoring

- **Knowledge**
  - Mathematics
  - Mechanical skills
  - Design
  - Engineering and Technology
  - Computers
CAD/CAM & CNC

• CAD is a valuable skill
  – Many careers require CAD skills
  – Most CAD design jobs requires a 4 year degree

• CAD/CAM is a valuable set of skills
  – CAD/CAM = Automation of machines & inspection
  – Most CAD/CAM & CNC jobs requires a 2 year degree

  • CAD – computer aided design
  • CAM – computer aided machining programming
  • CNC – computer numerical control programming
  • CMM – coordinate measurement machine programming
CAD/CAM Careers

• Main careers areas
  – CAD design
  – Conventional machining – tool making
    • Maintenance – millwright
  – CNC machining
  – CAM programming
  – Quality control – inspection
  – Automation
    • Flexible manufacturing
  – MFG engineer
Type of Industries

Over 120 Machining & Fabricating companies in N. Michigan & Eastern U. P.

• Aerospace & Defense
• Automotive
• Energy
• Heavy Equipment
• Medical
• Mining & Drilling
• Clean, healthy work environment
<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses</th>
<th>Notes</th>
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<tbody>
<tr>
<td>1st Semester</td>
<td>Machining Processes I</td>
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<td>Print Interpretation</td>
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<td>3D Modeling</td>
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<td>Introduction to CNC</td>
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<td></td>
<td>Political Science*</td>
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<td>CAD Elective</td>
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* = Required for AAS Degree
Multiple career paths

- Up & Out
  - Supervision
  - Design
  - Programming
  - Inspection

- Transfer to Engineering

- Automation

- Robotics

- Program
Careers in the CAD/CAM Industry
CAD Design

• CAD operators/drafter
  – use CAD systems to prepare drawings & prints.
  – They may work for engineers, architects and other professionals in producing plans and drawings

• CAD designers
  – Check dimension of parts, materials to be used, relation of one part to another, and relation of various parts to whole structure or project.
  – Utilize knowledge of various machines, engineering practices, mathematics, building materials, and other physical sciences to complete drawings.
CAD Design

• Tool Design
  – Designs a wide variety of tools including cutting and forming tools.
  – Works with engineering & shop personnel to resolve design problems related to material characteristics, dimensional tolerances, service requirements & manufacturing procedures.
  – Draws preliminary sketches and prepares layout and detail drawings, using CAD design/drafting software.
  – Modifies tool designs according to trial or production service data to improve tool life or performance.
CNC Machinist Operator/Programmer

• Duties vary from shop to shop
• Skills include how to:
  – Visualize a CNC program
  – Load program into machine
  – Write short manual G&M programs
  – Understand machining processes and the sequence of operations
  – Select cutting tools, adjust wear offsets
  – Make machine & tooling setups
  – Calculate speeds and feeds
CNC Machine Programmer

• Duties vary from shop to shop

• Skills include how to:
  – All the skills of a CNC machinist
  – CAD & CAM computer skills
  – Be skilled in print reading
  – Have a good knowledge of computer programming languages and procedures
  – Be able to visualize machining processes and operations
Quality Control Inspector

• Checks and examines machined parts to determine whether they meet specifications
• Have technical or vocational education
• Skills necessary
  – Understand and read mechanical drawings
  – Make basic mathematical calculations
  – Use micrometers, gages, comparators, and precision measuring instruments
Job Classifications

• Technician
  – Works at level between professional engineer and machinist
  – May assist engineer with cost estimates & technical reports

• Technologist (testing)
  – Works at level between graduate engineer and technician
  – 3-4 year graduates from technical college
    • Design studies, production planning & lab experiments
  – Does the work of an engineer without the pay
Job Classifications - Continued

• Tool and Die maker – Highly skilled craftsperson
  – Able to make different types of dies, molds, cutting tools, jigs, and fixtures
  – Serve an apprenticeship, have above-average mechanical ability, operate all standard machines

• Engineering technologist (non Degreed)
  – Do many jobs normally performed by an engineer
  – Often employed in middle management

• Supervisor
  – Hire, train & assist new employees
  – Run the shop including most equipment
  – Deal with budgets & discipline issues
MFG Engineer

• New Product launches
• Process improvement on existing products
• Problem solver
• Referee

• What makes a good MFG engineer
  – Hands on skills
  – Doesn’t want to be tied to a desk
  – Getting a C in Calculus
PPE

• Safety Glasses – always
  – Even in the Layout & Inspection rooms
• Clothes and Hair
• Safe Conduct in the Shop
Speeds & Feeds

• Proper RPM & Feed rate, determine the tool life of the cutter

• RPM has the greatest affect on Tool wear

• Materials that have similar microstructure/grain structure will have similar machining characteristics

• These material are grouped together on the basis of their microstructure (hardness)
HSS RPM Calculations

- CS = Cutting Speed
- D = Diameter of rotating part or cutter
- RPM = \( \frac{CS \times 4}{D} \) (Practical formula)

- **Form cutters** - Threading, Necking, Reaming, Counter boring, & Counter sinking use 1/3 the RPM

- Typical Feed rates/range for lathe
  - Roughing cuts: .010 to .015 feed per rev
  - Finishing cuts: .003 to .005 feed per rev
CS = Cutting Speed

- Based on material

<table>
<thead>
<tr>
<th>Material</th>
<th>Rough Cut</th>
<th>Finish Cut</th>
<th>Threading</th>
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<tr>
<td></td>
<td>ft/min</td>
<td>m/min</td>
<td>ft/min</td>
</tr>
<tr>
<td>Machine steel</td>
<td>90</td>
<td>27</td>
<td>100</td>
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<td>Tool steel</td>
<td>70</td>
<td>21</td>
<td>90</td>
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<tr>
<td>Cast iron</td>
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<td>18</td>
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<tr>
<td>Bronze</td>
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<tr>
<td>Aluminum</td>
<td>200</td>
<td>61</td>
<td>300</td>
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**RPM chart**

- Clausing Drill press

<table>
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<tr>
<th>DRILL DIA.</th>
<th>STEEL</th>
<th>ALUMINUM</th>
<th>STAIN. STEEL</th>
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<tr>
<td>1/16</td>
<td>3000</td>
<td>FULL SPEED</td>
<td>1520</td>
</tr>
<tr>
<td>1/8</td>
<td>1520</td>
<td>FULL SPEED</td>
<td>760</td>
</tr>
<tr>
<td>3/16</td>
<td>1020</td>
<td>4800</td>
<td>510</td>
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<td>1/4</td>
<td>760</td>
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<tr>
<td>5/16</td>
<td>610</td>
<td>2400</td>
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<tr>
<td>3/8</td>
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<td>2030</td>
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<td>1740</td>
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<tr>
<td>5/8</td>
<td>300</td>
<td>1220</td>
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**Model No.** 1150

**Serial No.** 3-3463-1
Phone Apps

- There is a APP for that
  - Cutting tool companies have free APP’s for RPM calculations using their carbide inserts
Calipers can be used to make outside, inside, and depth measurements.
Explanation of Caliper

- The bar is divided into .100 increments.
- The caliper dial is divided into 100 divisions.
- The reading is made by combining the division on the bar and the dial reading.
Caliper: Continued

- The dial hand makes one full revolution for each .100 movement.
- Each dial graduation, = .001 therefore represents .001 X 100 = .100
- Always place the calipers in their protective box after each use
Caliper Image

One revolution
0 to 0 = .100

.001

.010
Caliper Practice
Caliper Practice #4
Caliper Safety

Is this safe to the caliper?
HAAS Control Series

Panel Layout

Power ON

Reset & Power Up
Hass TL-1 CNC Lathe

- Manual/CNC lathe
- Power up, make sure Tail Stock is at the far right
- Hold Pendant
Manual Mode

- Move table by hand
- Read the screen
MDI (Manual Data Input)

- Answer questions
- Generate code
- Run machine
Projects

- Split in 2 groups, then switch
  - CNC lathe part
  - Cut, Mill & Drill clock
    - CNC mill/engrave face
    - Assemble clock
Clock

• Cut & prep material for CNC mill
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