

Experiences in Designing a Design for Manufacturing Course

Dr. Richard Jerz, Dr. Gary Fischer
St. Ambrose University / The University of Iowa

RickJerz@cs.com

Gary-fischer@uiowa.edu

Brief History – DFM

- **The University of Iowa – Spring 04**
- **Replace “Manufacturing Processes”**
- **Wanted a stronger connection between design & manufacturing**
- **Required course for ME & IE students**
- **Components (product design emphasis):**
 - **Manufacturing Processes**
 - **Engineering Graphics**
 - **NC Programming/CAD/CAM**

Why me?

- **Cannot get faculty volunteers**
- **Manufacturing is not “glamorous” research**
- **CAD expertise was limited**
- **I had the background and interest**

Format for DFM Course

- **15 week semester**
- **3 – 50 minute lectures**
- **1 – 50 minute lab**
- **3 hours total credit**
- **Sophomores and Juniors**

Course Topics

- **Ambitious plan, what should be included?**
 - **Faculty input**
 - **Industry input: Design and manufacture**
 - **SMEs Manufacturing Execution Plan:**
 - » CAD skills
 - » Blueprint reading
 - » Manufacturing processes
 - » Teamwork
 - » Oral and written communication
 - **My ideas and interests**

Manufacturing Processes

- **Milling, turning, drilling, forging, shearing, bending, sand & die casting, fusion and solid-state welding, plastics, composites, inspection, surface treatment**
- **Function, quality, cost, and time**
- **Learning model**
 - **Lectures, videos, homework problems, exams**

Homework Example

A face-milling operation is used to machine 5 mm from the top surface of a rectangular piece of aluminum 400 mm long by 100 mm wide. The cutter has four teeth (cemented carbide inserts) and is 150 mm in diameter. Cutting conditions are $v = 3$ m/s, $f = 0.27$ mm/tooth, and $d = 5.0$ mm. Determine (a) time to make one pass across the surface, (b) metal removal rate during cutting, and c) the power required. Use metric calculations and assume average material hardness.

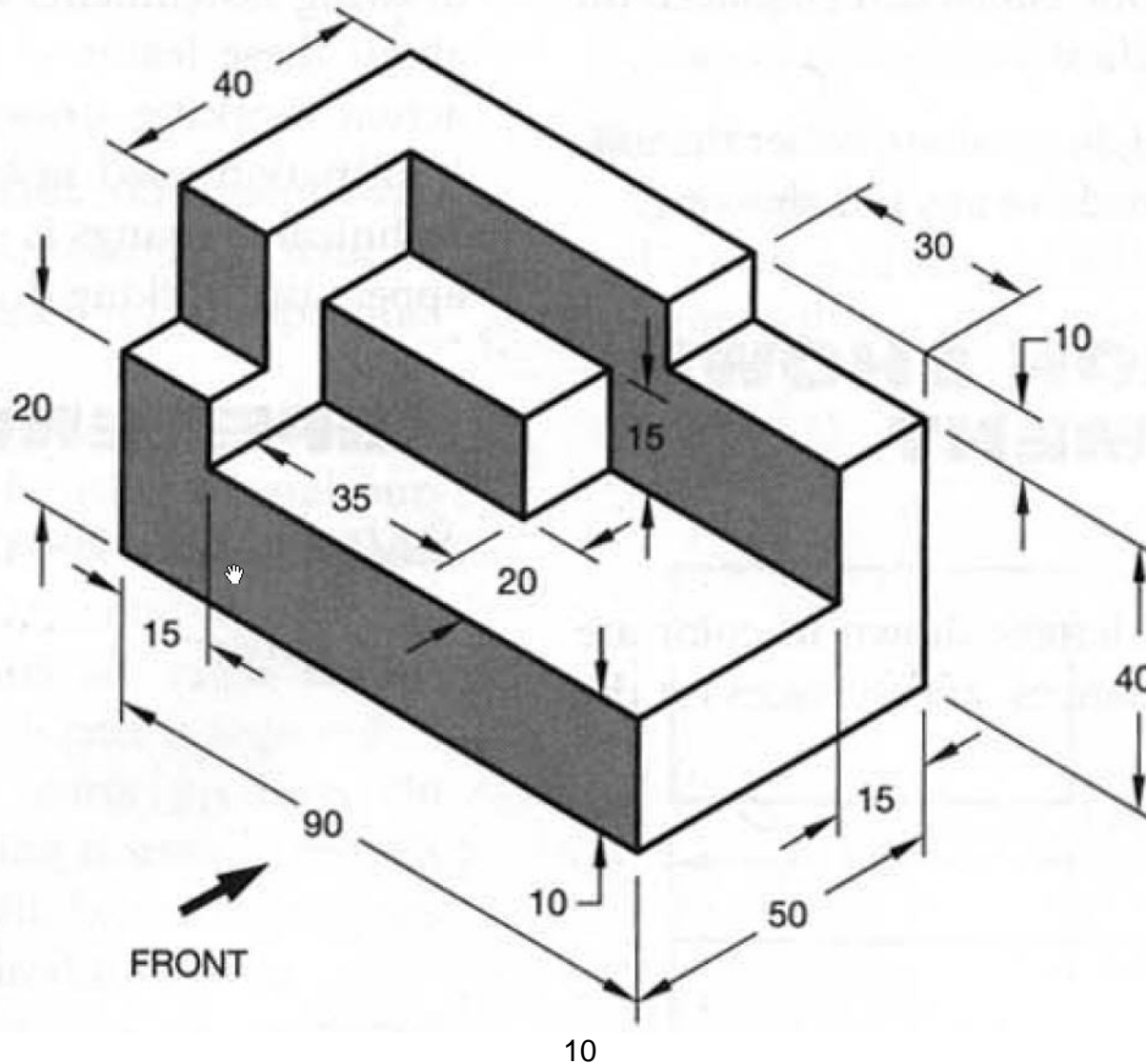
Video Example



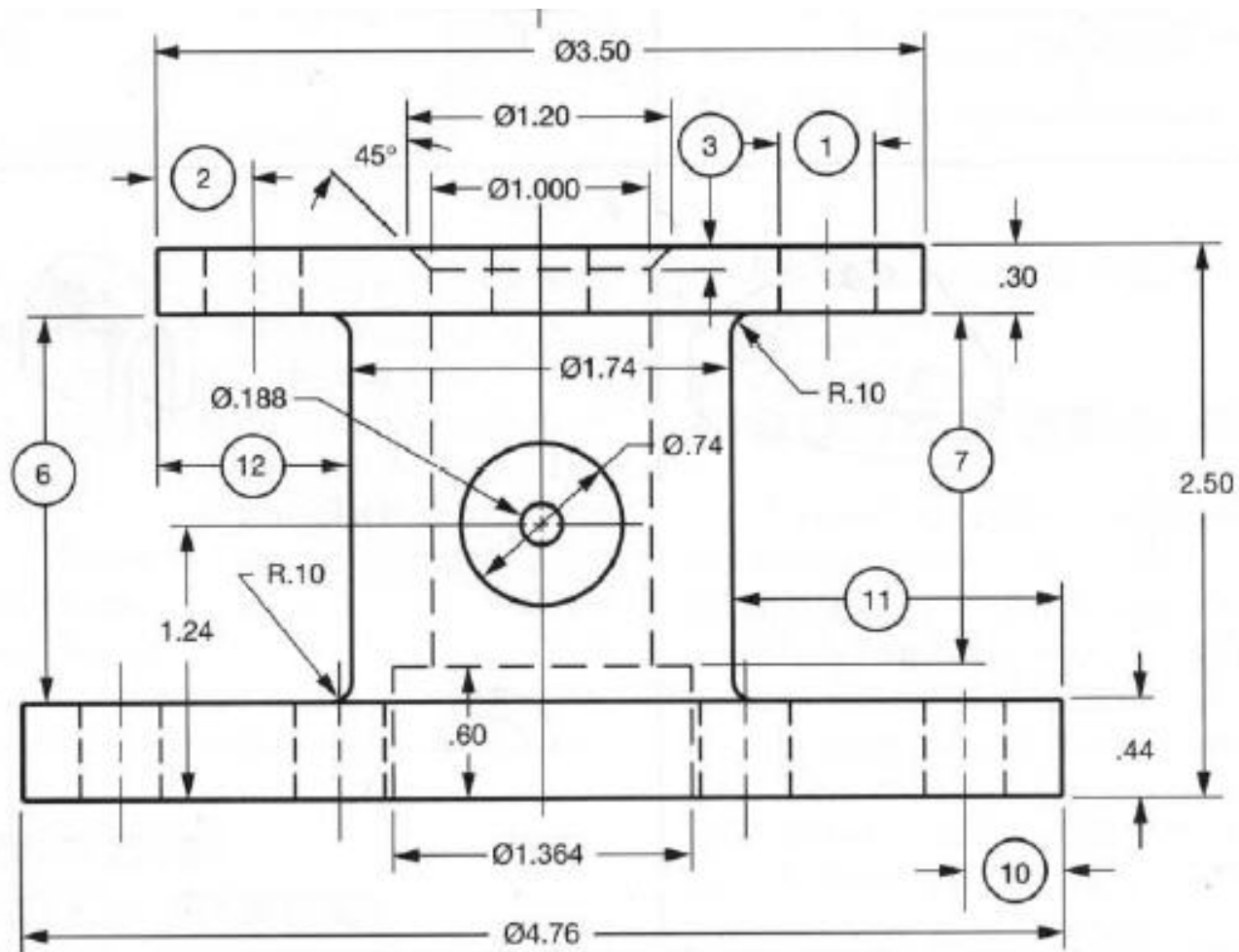
Engineering Graphics

- **Focus: Sketching, drawing creation, drawing interpretation**
- **Orthographic and isometric views, working drawings, dimensioning, surface finish and machining symbols, inclined and rotational surfaces, isometric drawing, chamfers, repeated features, sheet metal developments, primary views, and auxiliary views**
- **Learning model**
 - **Lectures, videos, homework problems, exams**

Homework Example (sketching)



HW EX: (drawing interpretation)



HW EX: (drawing interpretation)

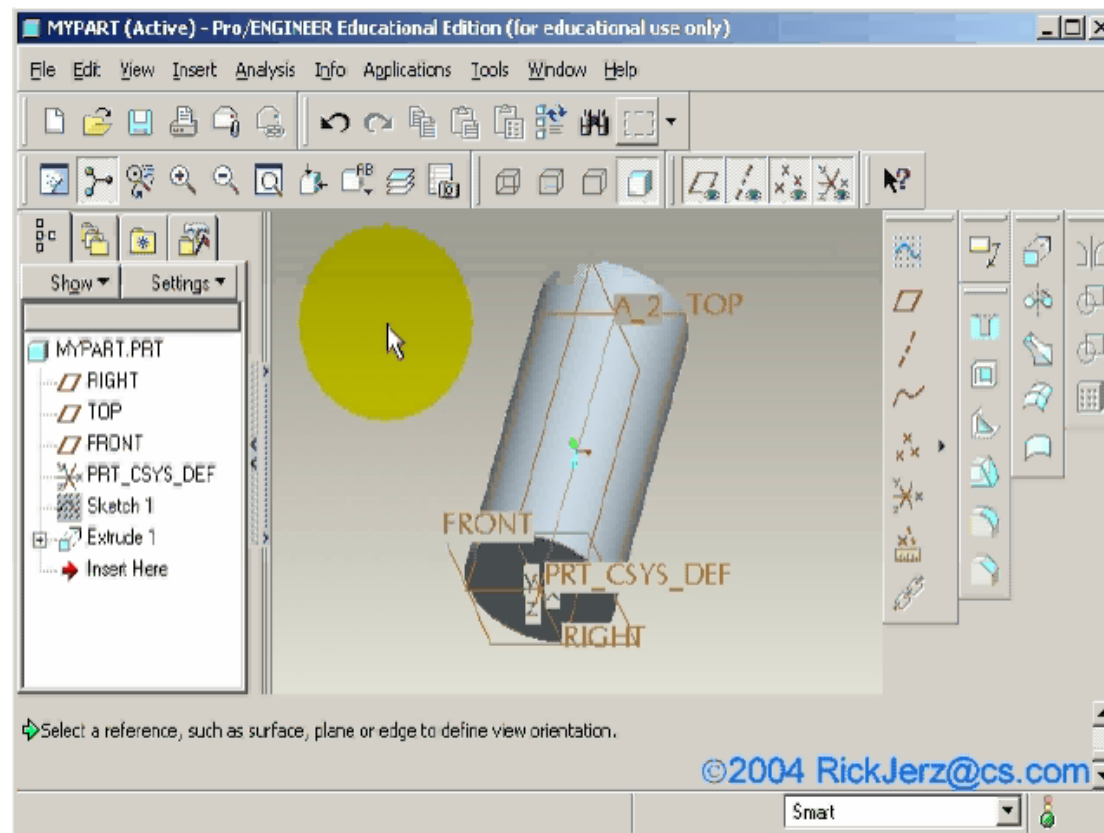
QUESTIONS

1. What are the diameters or circles (A) to (H)?
2. How many holes are in the bottom surface?
3. How many holes are in the top surface?
4. How deep is the $\varnothing 1.000$ hole from the top of the coupling?
5. What is angle (J)?
6. How thick is the largest flange?
9. Calculate distances (1) to (13).

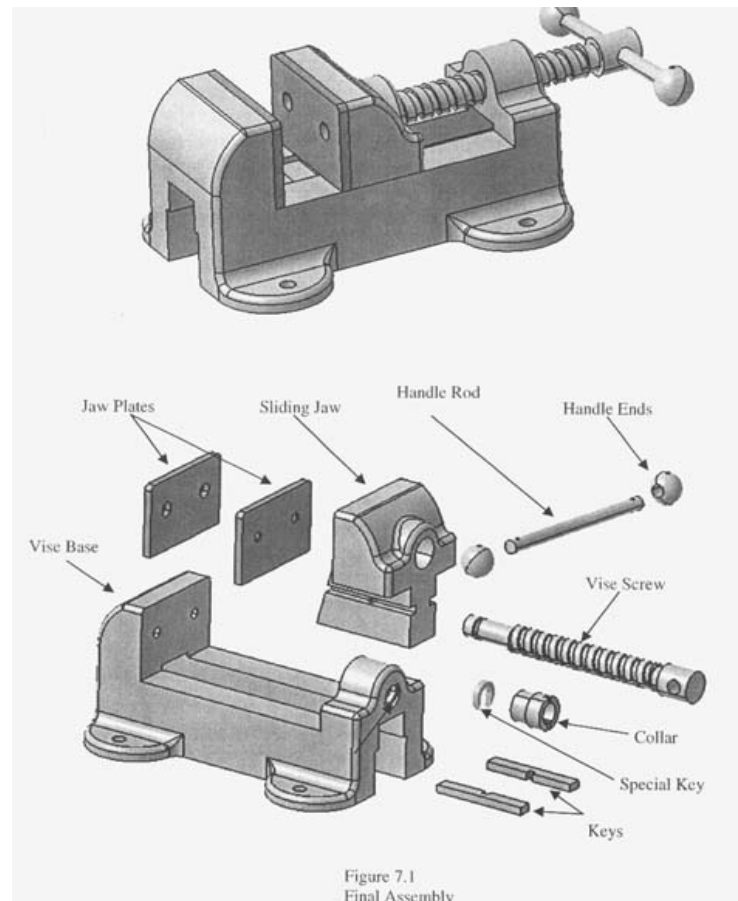
NC, CAD, & CAM (14 Labs)

- **Resources: Computer labs, Techno Mill and Lathe**
- **9 ProE labs (modeling, drawings, assemblies)**
- **NC Programming (example)**
- **Milling (examples)**
- **Turning**
- **Rapid Prototype**
- **Inspection (concepts, gages, and measuring)**
- **Learning model**
 - **Lectures, videos, homework problems, exams**

Pro/E Instructional Video



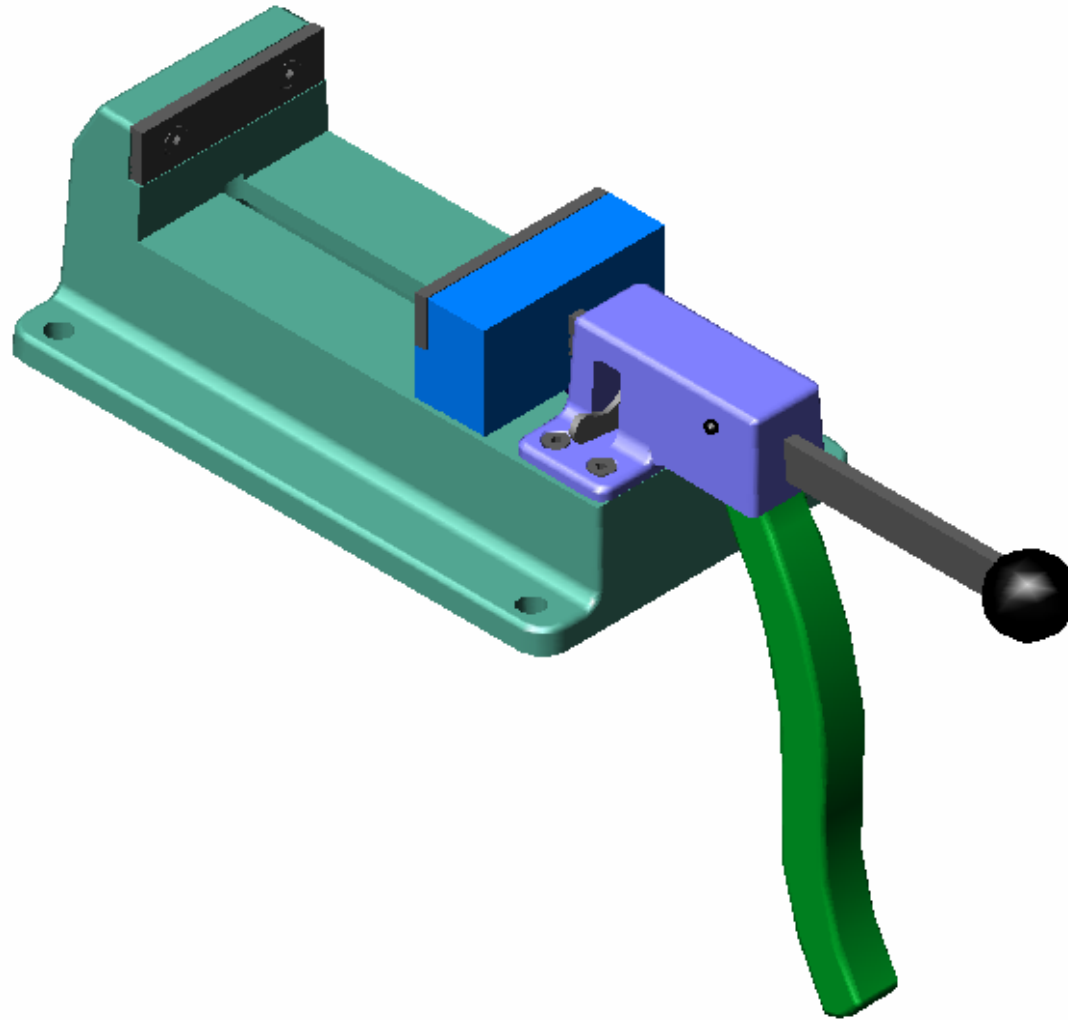
Integrated Design Project: Redesign Vise



Project Components

- Semester long
- Open ended
- Team project (3-5 students)
- Professional report (standard Word template used)
- Include: Sketches, CAD models, working drawings, manufacturing process details
- RP part, milled and turned part
- Manufacturing company tour
- Presentation (optional)
- Student grading

Example of Student Vise



Results

- **Offered 3 semesters (~ 170 students)**
- **Seems to be working**
- **Relationship between design & manufacturing occurs**
- **Student comments:**
 - **Many students seem to like it**
 - **Too much work**
 - **Too easy, too hard**
 - **Related to job opportunities**

Issues

- **Textbooks**
- **CAD & CAM software**
- **Breadth versus depth**
- **Exams**
- **TA support**
- **Class-time management important!**

Future Direction

- **Increase content, and delivery of content**
- **Virtual lab – Delmia**
- **Delmia for CAD/CAM**