

Product Planning & Development (21-423)

*Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology*

Session #21



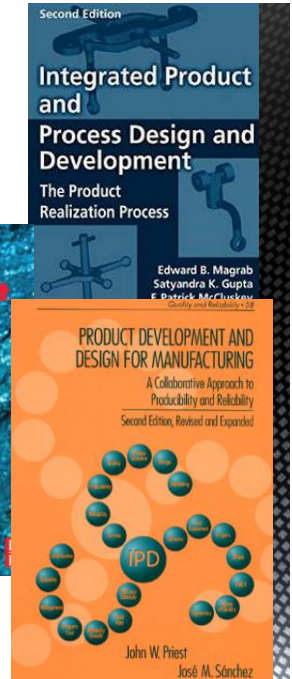
Course Description

- ***Instructor***
 - *Omid Fatahi Valilai, Ph.D. Industrial Engineering Department, Sharif University of Technology*
 - *Email: FValilai@sharif.edu, Tel: 6616-5706*
 - *Website: Sharif.edu/~fvalilai*
- ***Recommended prerequisite***
 - *Manufacturing process I (21-418)*
- ***Class time***
 - *Sunday-Tuesday 18:00-19:30*
- ***Course evaluation***
 - *Mid-term (25%)*
 - *Final exam (40%)*
 - *Quiz (5%)*
 - *Exercise (Manufacturing Lab.) (30%)*

Session reference

Reference:

- Edward B., “Integrated product and process design and development : the product realization process”, CRC Press, 2010
- John Priest, Jose Sanchez; “Product Development and Design for Manufacturing: A Collaborative Approach to Producibility and Reliability, Second Edition”, CRC Press, 2001
- Mital et al. , “Product Development A Structured Approach to Consumer Product Development, Design, and Manufacture”, Butterworth-Heinemann, 2008



Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University of Technology
Product Planning & Development (21423), Session #21

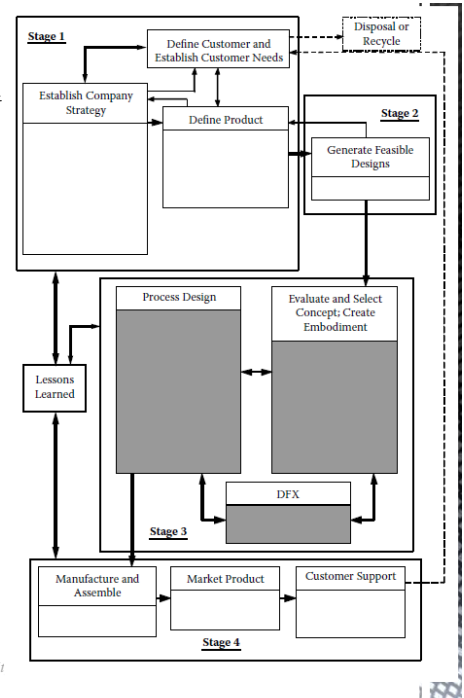
Course Description (Continued..)

- **Contents:**
- Product development in the changing Global world
- Stages of Product Development
- The Structure of the Product Design Process
- Early design: Requirement definition and conceptual Design
- Trade-off analyses: Optimization using cost and utility Metrics
- Detailed design: Analysis and Modeling
- Design Review: Designing to Ensure Quality
- Production System; Strategies, planning, and methodologies
- Production System Development
- Planning and Preparation for Efficient Development
- Supply chain: Logistics, packaging, supply chain, and the environment

Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University of Technology
Product Planning & Development (21423), Session #21

Planning and Preparation for Efficient Development

▪ Design for Manufacturing



Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University
Product Planning & Development (21423), Session #21

Planning and Preparation for Efficient Development

▪ Design for Manufacturing (DFM)

- Shrinkages can cause induced stresses and distortion in casted components. The amount of shrinkage varies with the type of metal used for casting but can be predicted and compensated for by making patterns slightly oversized.
- Although casting is a process that can be used to produce complex part geometries, simplifying the part design improves its castability.
- Avoiding unnecessary complexities simplifies the mold making, reduces the need for cores, and improves the strength of the casting.

Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University of Technology
Product Planning & Development (21423), Session #21

6

Planning and Preparation for Efficient Development

▪ Design for Manufacturing (DFM)

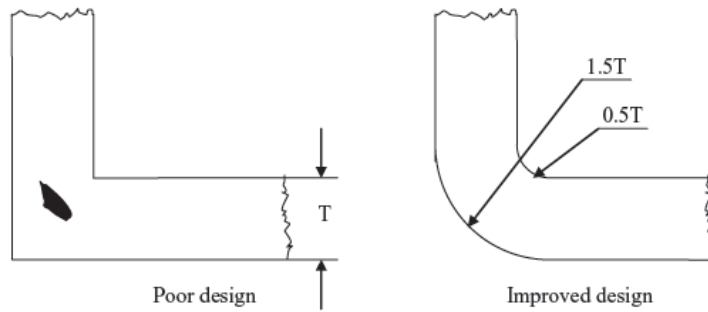


Figure 6.6 Provide generous radii to sharp corners to avoid uneven cooling and molded-in stress.

Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University of Technology
Product Planning & Development (21423), Session #21

7

Planning and Preparation for Efficient Development

▪ Design for Manufacturing (DFM)

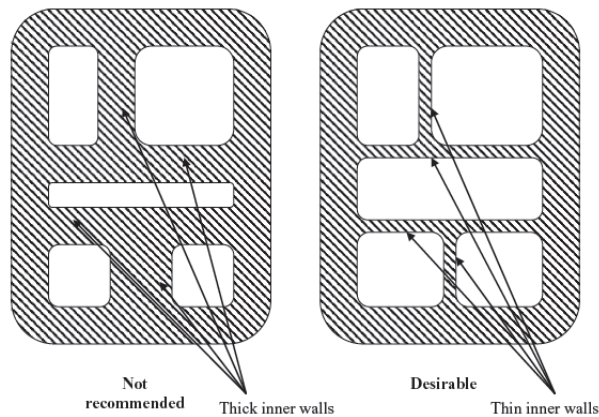


Figure 6.7 Interior walls should be 20% thinner than exterior walls, since they cool more slowly.

A

8

Planning and Preparation for Efficient Development

- *Design for Manufacturing (DFM)*
 - *The parting line should be in a plane perpendicular to the axis of the die motion.*
 - *If it is not possible to have the parting line on one plane, it is desirable to preserve the symmetry to prevent high side-thrust forces on the die and the press.*
 - *No portion of the parting line should incline more than 75 degrees from the principal parting plane, and much shallower angles are desirable.*
 - *Undercuts cannot be incorporated into forged components since the forging must come out of the die after it is made.*

Planning and Preparation for Efficient Development

- *Design for Manufacturing (DFM)*
 - *The major limitation and specific design recommendation for a part to be extruded is that the cross-section must be same for the length of the part being extruded.*
 - *Avoid sharp corners. Provide generous radii for both internal and external corners of extruded cross sections.*

Planning and Preparation for Efficient Development

▪ Design for Manufacturing (DFM)

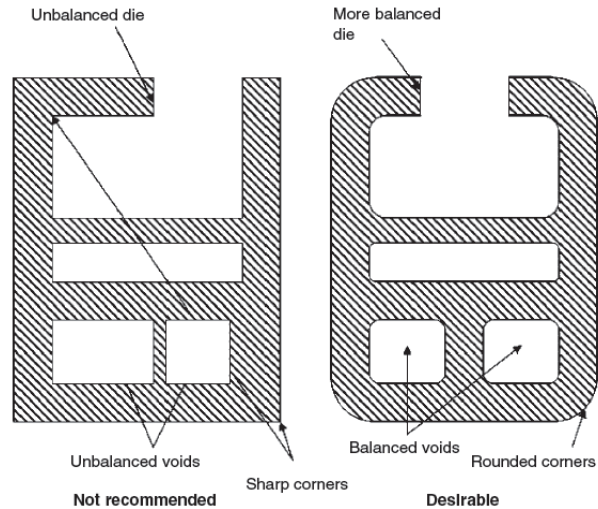


Figure 6.8 Desirable and undesirable practices in the design of cross sections to be extruded.

Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University of Technology
Product Planning & Development (21423), Session #21

Planning and Preparation for Efficient Development

▪ Design for Manufacturing (DFM)

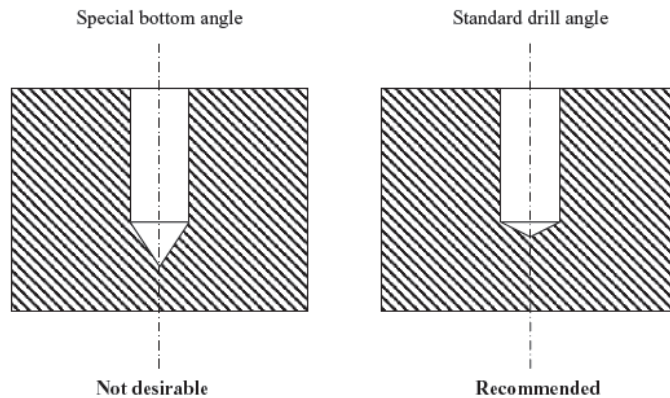
- *If possible, parts should be designed such that they do not need machining. If this is not possible, then minimize the amount of machining required.*
- *In general, a low-cost product is achieved through the use of net shape processes, such as precision casting, closed die-forging or plastic molding, or near net shape processes, such as impression die forging.*
- *Machined parts should be designed such that the features can be achieved with standard cutting tools. Utilize standard pre-shaped work-pieces to the maximum extent.*

Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University of Technology
Product Planning & Development (21423), Session #21

12

Planning and Preparation for Efficient Development

- **Design for Manufacturing (DFM)**
 - Try to design components so that they can be machined with only one machine tool



Advanced 1

Figure 6.14 Use standard cutting tools rather than special tools.

13

Planning and Preparation for Efficient Development

- **Design for Manufacturing (DFM)**
 - Tolerances should be specified to satisfy functional needs, but the capabilities of a process also should be considered.
 - Machined features such as sharp corners, edges, and points should be avoided, as they are difficult to accomplish.
 - Deep holes that must be bored should be avoided.
 - Parts should be designed rigid enough to withstand the forces of cutting and work holder clamping

Advanced Manufacturing Laboratory, Department of Industrial Engineering, Sharif University of Technology
Product Planning & Development (21423), Session #21

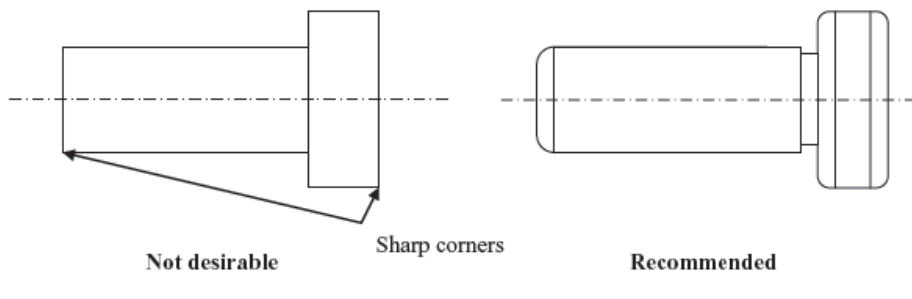
14

Planning and Preparation for Efficient Development

- **Design for Manufacturing (DFM)**
 - Try to ensure that cylindrical surfaces are concentric and plane surfaces are normal to the component axis.
 - Avoid internal features for long components. Also avoid components with a very large or very small length-diameter ratio.
 - Components should be designed such that standard cutter shapes and sizes can be used.
 - Slot widths, radii, chamfers, corner shapes, and overall forms should conform to those of the cutters available rather than ones that would require special fabrication.

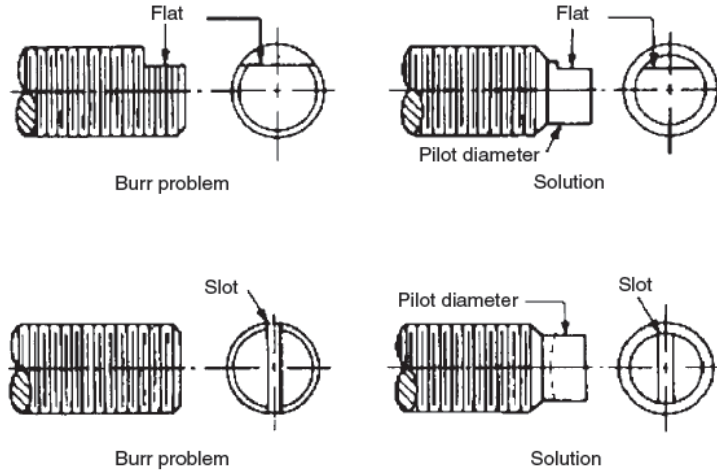
Planning and Preparation for Efficient Development

- **Design for Manufacturing (DFM)**



Planning and Preparation for Efficient Development

▪ *Design for Manufacturing (DFM)*



Product Planning & Development (21423), Session #21

17

Project

- *Phase 12*
 - *Product DFM Analysis*

