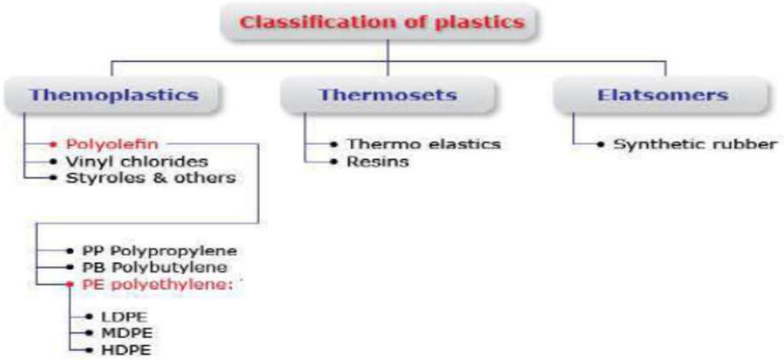
DESIGN GUIDELINES FOR PLASTICS, RUBBER AND CERAMIC

Dr. Dhiren R. Patel

Plastics

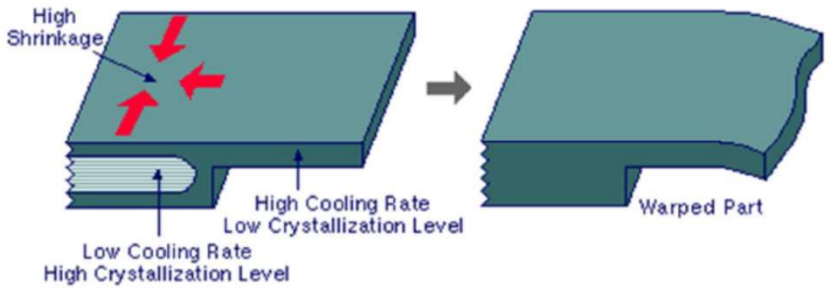
- A polymer is a compound consisting of long-chain molecules, each molecule made up of repeating units connected together
- Polymers can be separated into plastics and rubber. As engineering materials, they are relatively new compared to metals and ceramics, dating only from around the mid-1800s.



1 PETE	2 HDPE	3 PVC	4 LDPE	5 PP	6 PS	7 OTHER
polyethylene terephthalate	high-density polyethylene	polyvinyl chloride	low-density polyethylene	polypropylene	polystyrene	other plastics, including acrylic, polycarbonate, polyactic fibers, nylon, fiberglass
soft drink bottles, mineral water, fruit juice containers and cooking oil	milk jugs, cleaning agents, laundry detergents, bleaching agents, shampoo bottles, washing and shower soaps	trays for sweets, fruit, plastic packing (bubble foil) and food foils to wrap the foodstuff	crushed bottles, shopping bags, highly-resistant sacks and most of the wrappings	furniture, consumers, luggage, toys as well as bumpers, lining and external borders of the cars	toys, hard packing, refrigerator trays, cosmetic bags, costume jewellery, audio cassettes, CD cases, vending cups	an example of one type is a polycarbonate used for CD production and baby feeding bottles
						

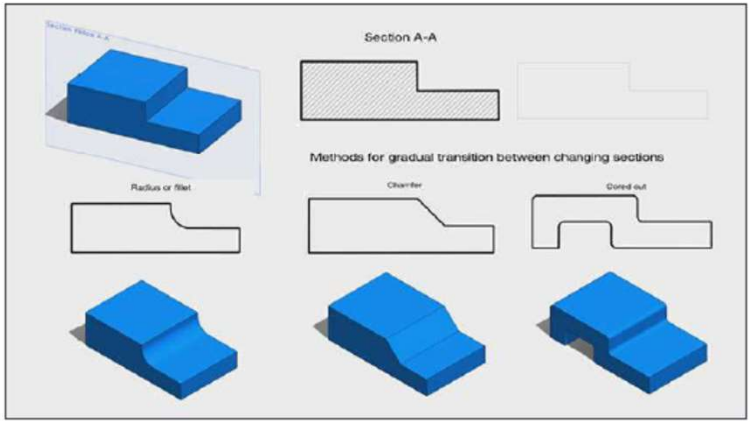
Design guidelines for Plastic

- **Wall thickness:** Uniform wall thickness is desirable in an extruded cross section. Variations in wall thickness result in non-uniform plastic flow and uneven cooling that tend to warp the extrudate.



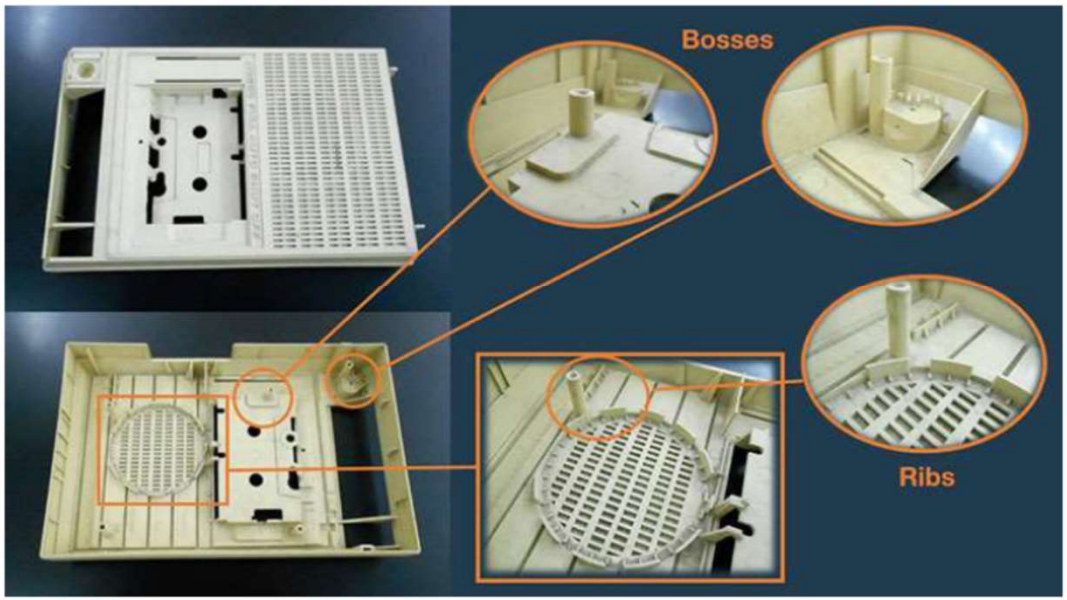
Design guidelines for Plastic

- Always try to keep wall thickness uniform
- There should be gradual transition between changing sections.
- Wall thickness for reinforced materials 0.75 mm to 3 mm and for unreinforced material it is 0.5 mm to 5 mm



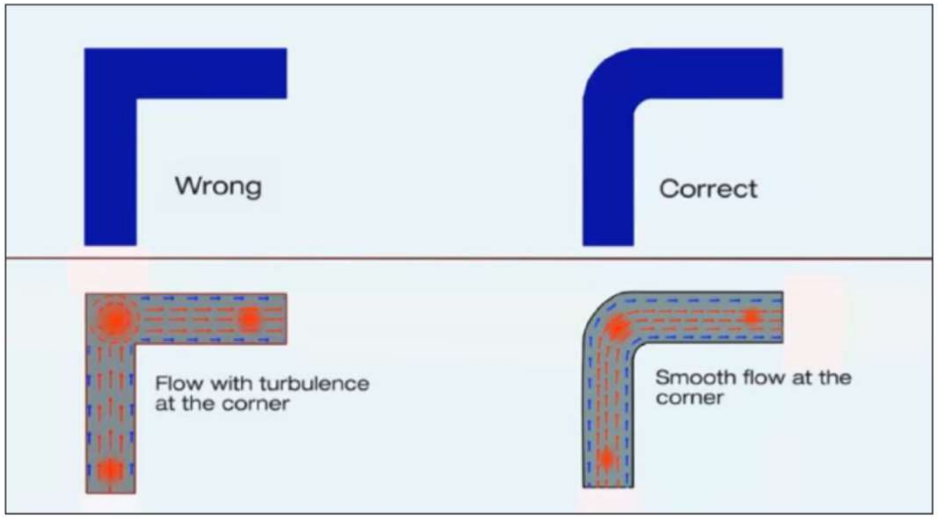
Design guidelines for Plastic

- **Hollow sections** complicate die design and plastic flow. It is desirable to use extruded cross sections that are not hollow yet satisfy functional requirements



Design guidelines for Plastic

- **Sharp corners, inside and outside**, [Notch sensitivity will occur] should be avoided in the cross section, Because they result in uneven flow during processing and stress concentrations in the final product.

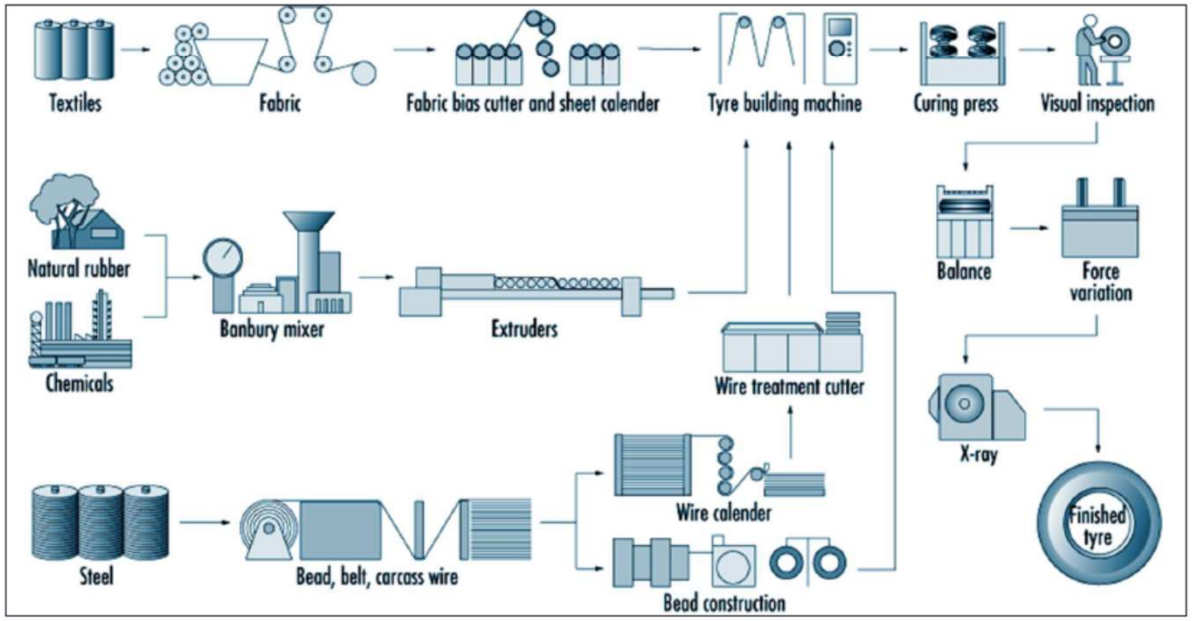


Design guidelines for Plastic

- **Economic production quantities:** Each molded part requires a unique mold, and the mold for any of these processes can be costly, particularly for injection molding.

Process	Minimum number of pieces
Injection Molding	> 10000
Transfer Molding	1000 to 10000
Compression molding	>1000

Manufacturing of rubber



Design guidelines for Rubber

- **Economic production quantities.** Rubber parts produced by compression molding (the traditional process) can often be produced in quantities of a thousand or less.
- The mold cost is relatively low compared with other molding methods. Injection molding, as with plastic parts, requires
- **Draft** is usually **unnecessary** for rubber molded parts. The **flexibility** of the material allows it to deform for removal from the mold.
- The low stiffness and high elasticity of the material permits removal from the mold.
- **Holes are difficult** to cut into the rubber after initial forming, due the flexibility of the material. It is generally desirable to mold holes into the rubber during the primary shaping process.

Design considerations for ceramics

- Ceramic components should be designed to be subjected to **compressive stresses**, not tensile stresses.
- Ceramic parts should not be used in applications that involve **impact loading or high stresses** that might cause fracture.
- **Deep holes, channels, and undercuts** should be avoided,
- **Part shrinkage** in drying and firing (for traditional ceramics) and sintering (for new ceramics) may be significant and must be taken into account by the designer in dimensioning and tolerancing
- **Screw threads** in ceramic parts should be avoided.