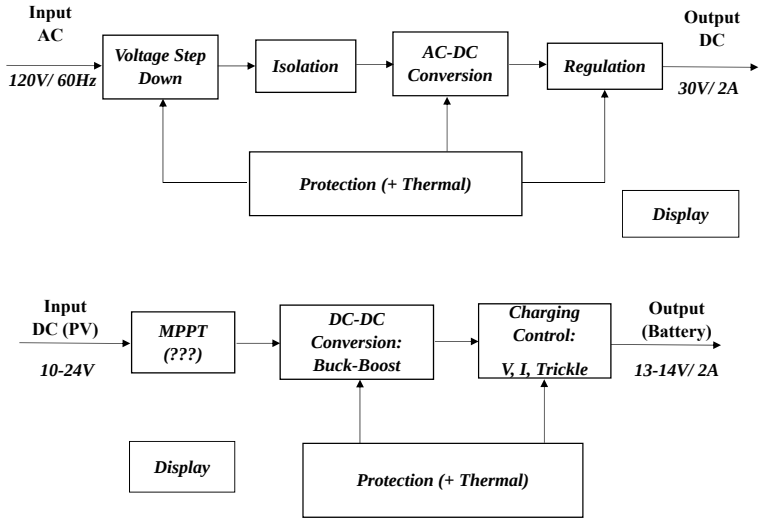
Possible Functional Blocks of Power Supply & Battery Charger (2018)



Design Process

5 Major Design Stages

- Idea Generation
- Conceptual Design
- Detailed Design (Design Embodiment)
- Prototype/Verifications
- Refinement/Final Design/Documentation

Detailed Design - Outcomes

Detailed design should yield the following outcomes (i.e. the design team should deliver the following results):

- Details of the products
  - Materials, components (BOM), dimensions, values
- Detailed drawings and specifications
  - Drawings/diagrams, specifications of materials and components, manuals, production procedures/plans etc.
- Costs and environmental impact
  - Component costs, production costs, marketing/distribution costs
  - Life cycle assessment, effects to environment and sustainability

Detailed Design - Process

- Function and subsystem structure - based on the results of Idea Generation
  - The entire product is decomposed of functional blocks
- Technical intensive solutions by the design team
  - Detailed calculations, simulations, solutions
- Design for 'X' (different purposes)
  - Design for manufacturing
  - Design for assembly
  - Design for environment, Design for safety etc.
- Integration of functions/subsystems
  - Complete product (initial)
- Verification and Modification
  - Design iterations: prototypes and simulations

Drawings of a Product
- tech. communications in engineering

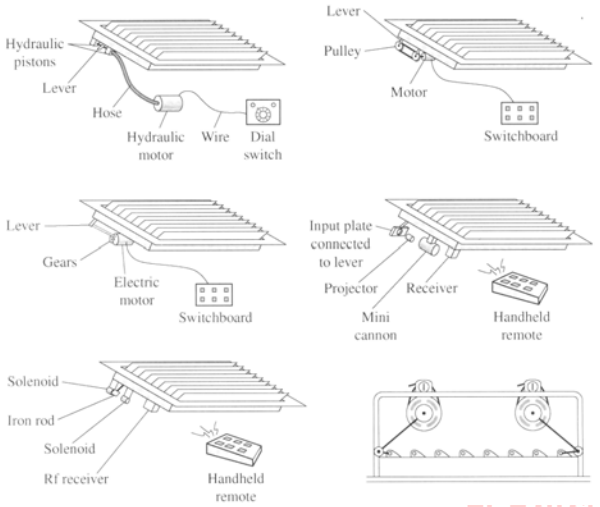
There are different types of drawings

- Sketches (layout drawings)
- Detail drawings
  - Complete and exact description of the part including shapes, dimensions, tolerances, surface finish and heat treatment (Mech); or **complete circuit diagram including connection, type, value, label etc.(Elec).**
- Assembly drawings
  - All the components drawn to scale
  - All the components drawn in the correct position
  - Minimum dimensioning
  - The component codes and descriptors are shown.

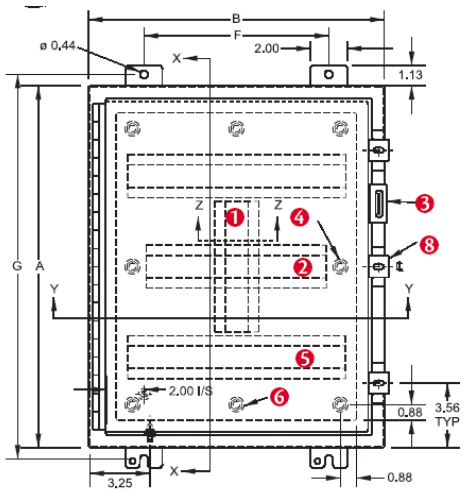
Sketches

Generated in the conceptual design stage, and refined

- Conceptual
- All functions
- To scale
- No tolerances
- No details

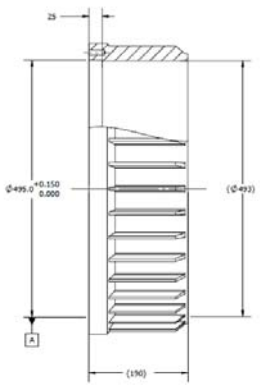


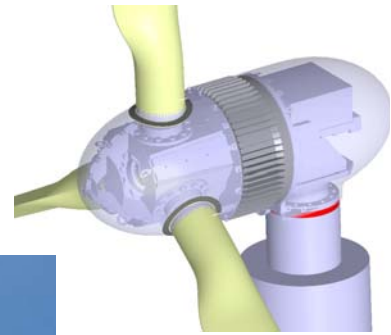
Detail Drawings - an enclosure



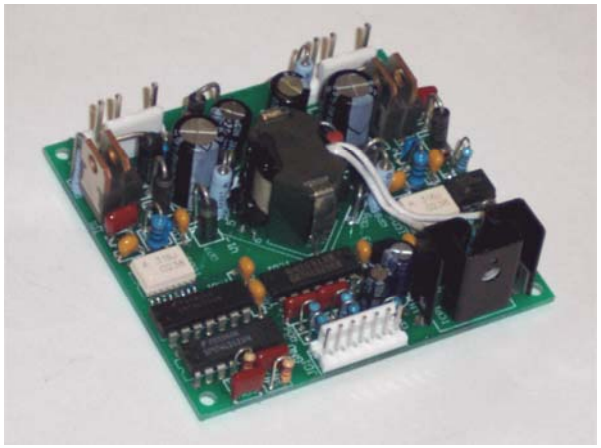
Front View

A PM Generator for Wind Turbines

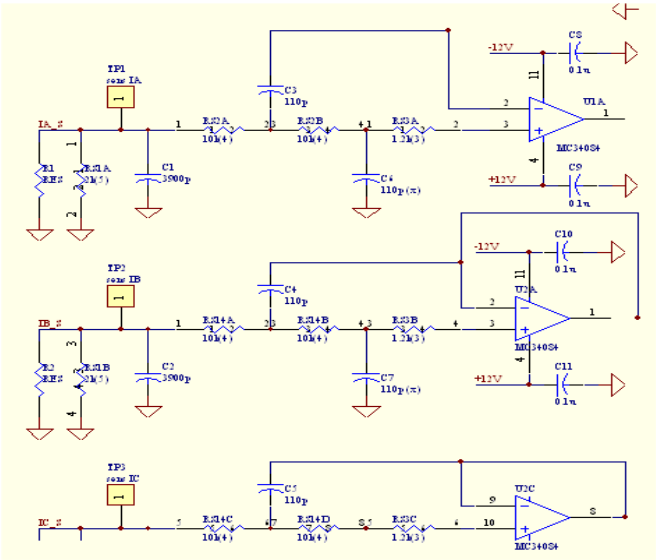




Detail Drawings - an electrical product

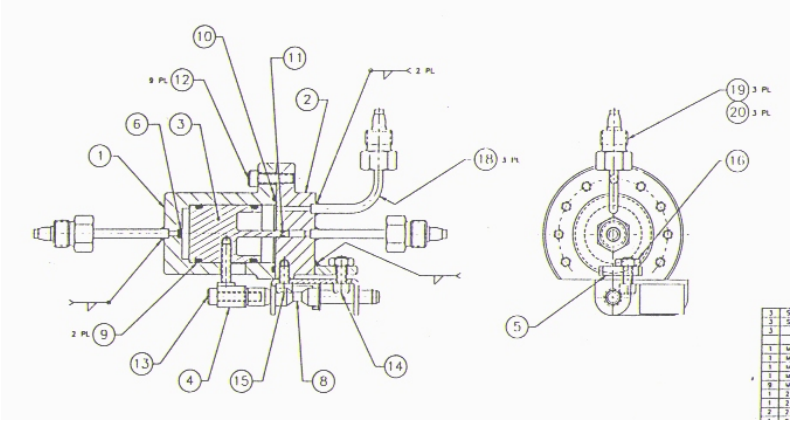


Detail Drawings - electric schematics



Assembly Drawings

Show how components fit together



Bill of Material - index of parts

Include all components of an assembly

- Item number
- Part number (your company's designation)
- Quantity needed in the assembly
- Name and description of the component
- Model/material/package of the component
- Source and manufacturer of the component
- Cost of the component etc.

Samples of BOM

Item	Part	Quantity	Name	Material	Source	Cost
1	G-9042-1	1	Governer body	Cast aluminum	Lowe's	$56.04
2	G-9138-3	1	Governer flange	Cast aluminum	Lowe's	$8.60
...						
9	X-1784	4	Governer bolt	Plated steel	Apex Ind.	$0.99

(Electrical)

Item	Part	Quantity	Name/Description	Model/Type	Producer	Source	Cost
1	L-1001-1	1	SMPS IC (40V/2.5A)	LT1171CT	Linear Tech.	MunroElec.	$7.85
2	L-1001-2	1	Ele. Cap. (220u/16V)	ECE-A16Z220	Panasonic	Digikey	$0.54
...							
25	L-1001-2	1	Film resistor(2.0k/0.25)	CR-2K	Philip	FAI	$0.02

Note: BOM should also include package information, eg. 16-pin DIP package for ICs etc.

Process of Detailed Design -Start from Function Blocks

- Detailed process (giving in class using our power supply design as an example)
- Break the product into function blocks (done in Idea Generation)
- Determine the inputs and outputs of each block
- Determine the design specifications of each block
- Design the blocks or groups of blocks by sub-teams (embodiment)

Design for 'X' (purposes)

- Design for assembly
  - Making assembly of products easier
- Design for manufacture
  - Minimizing part count
- Design for safety
- Design for environment

.....

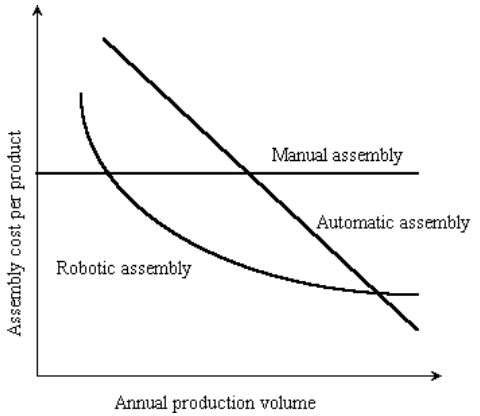
- Design for .....(X)

Design for Assembly

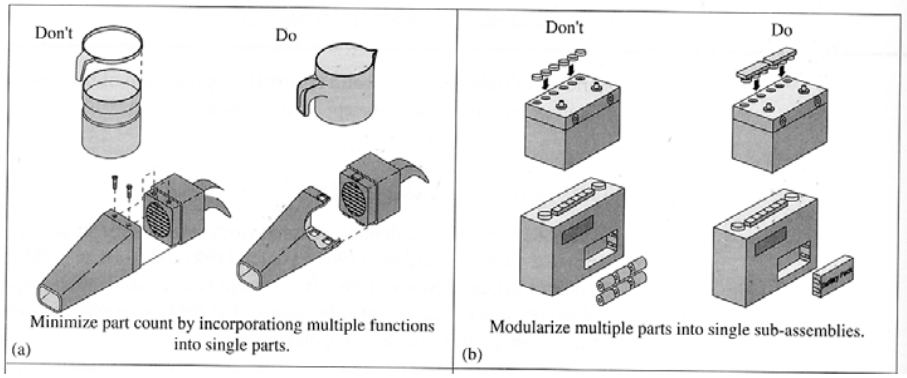
Focus on 'making assembly of products easier'

- Manual assembly
- Automatic assembly

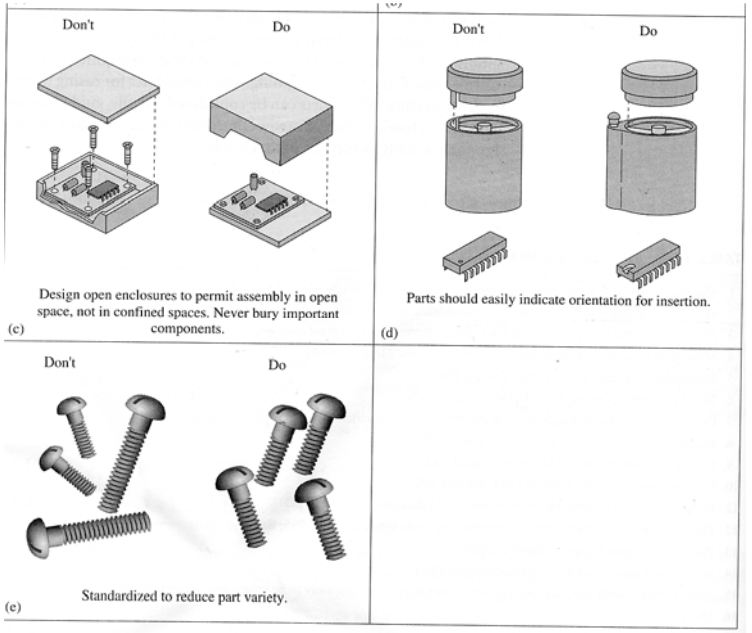
- System guidelines
- Handling guidelines
- Insertion guidelines



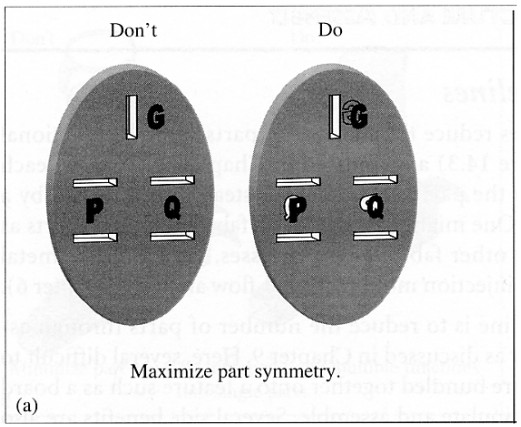
System Guidelines -1



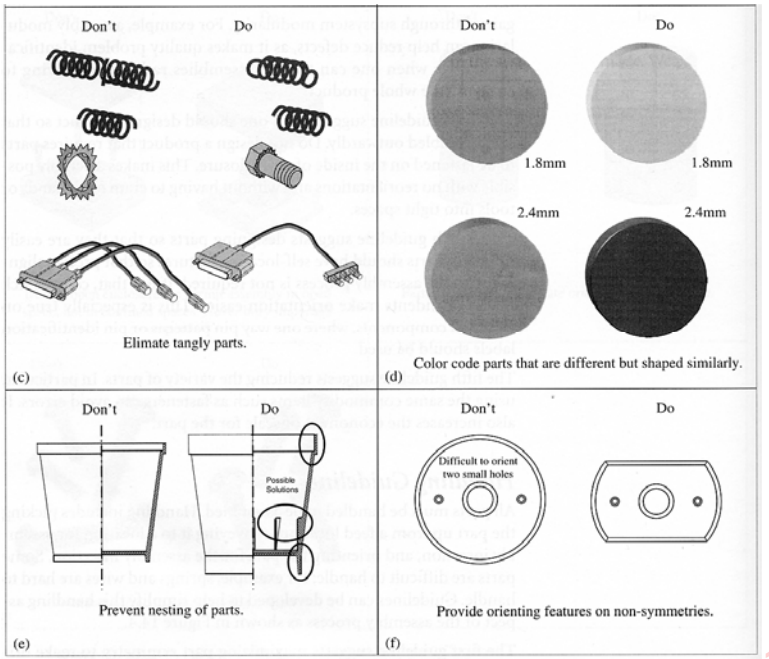
System Guidelines - 2



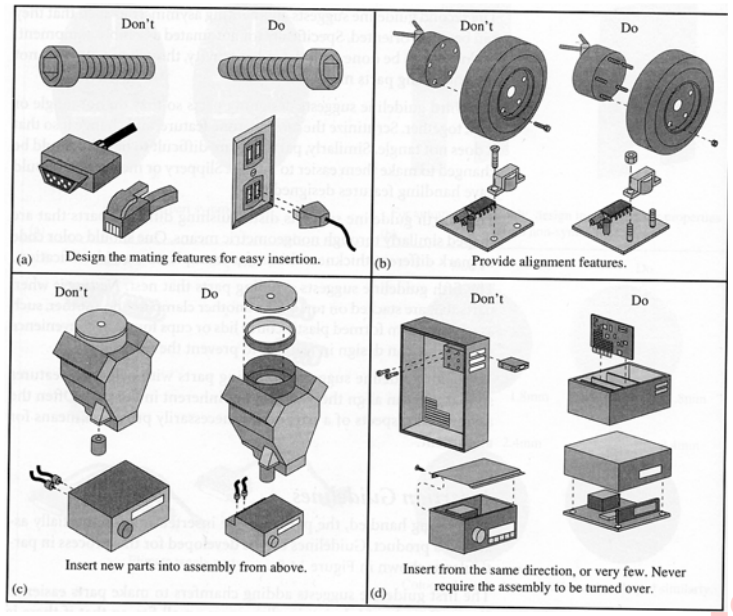
Handling Guidelines - 1



Handling -2



Insertion Guidelines



Summary of Guidelines for Design for Assembly

- Minimise part count by incorporating multiple functions into single parts
- Modularise multiple parts into single subassemblies
- Assemble in open space, not in confined spaces; never bury important components
- Make parts such that it is easy to identify how they should be oriented for insertion
- Prefer self-locating parts
- Standardise to reduce part variety
- Maximise part symmetry
- Design in geometric or weight polar properties if nonsymmetric
- Eliminate tangly parts
- Color code parts that are different but shaped similarly
- Prevent nesting of parts; prefer stacked assemblies
- Provide orienting features on nonsymmetries
- Design the mating features for easy insertion
- Provide alignment features
- Insert new parts into an assembly from above
- Eliminate re-orientation of both parts and assemblies
- Eliminate fasteners
- Place fasteners away from obstructions; design in fastener access
- Deep channels should be sufficiently wide to provide access to fastening tools; eliminate channels if possible
- Provide flats for uniform fastening and fastening ease
- Ensure sufficient space between fasteners and other features for a fastening tool
- Prefer easily handled parts

Design for Manufacturing

- A designer's primary objective is to design a functioning product within the given economic and schedule restraints.
- Decisions made during the design period determine 70% of the products cost while decisions made during production only account for 20% of the products cost.
- The success of product design requires early and active participation from Manufacturing, Marketing, Finance, Design Engineers, Quality, Service, Purchasing, Vendors, Regulatory, Compliance, and Technicians.

Design for Manufacturing - Principles

- Simplify and reduce the number of parts.
- Standardize and use common parts and materials.
- Design for ease of fabrication.
- Mistake-proof product design and assembly.
- Minimize flexible parts and interconnections.
- Design for efficient joining and fastening.
- Design for ease of service.
- Include 'robustness' into products.
- Avoid tight tolerances.