

Machine Design

What is the importance of Machine Design for engineers?

What is Machine Design?

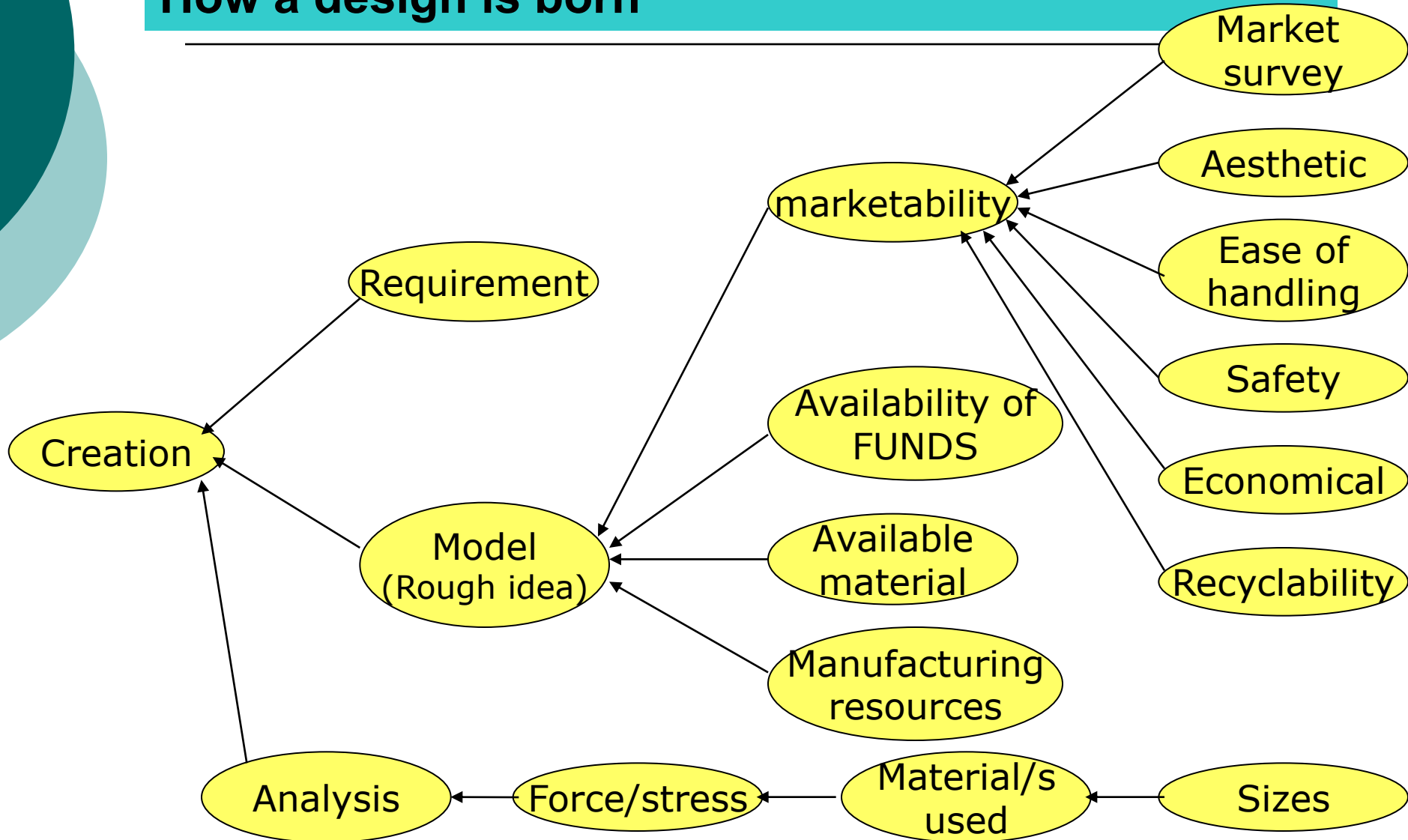
Creation of new and better machines AND

Improving existing ones

So that it is economical in the cost of production and operation.

Machine Design

How a design is born



What is the basic knowledge required for Machine Design?

- Mathematics
 - Engineering Mechanics
 - Mechanics of Machines
 - Mechanics of Materials
 - Fluid Mechanics & Thermodynamics
 - Strength of Materials
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- Workshop Processes
 - Engineering Drawing
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- Computing
 - Finite Element Analysis, Computational Fluid Dynamics etc

Important considerations in Machine Design

1. Type of **LOAD** and **STRESS**es caused by the load

- Dead loads

- Live loads

 - Steady loads

 - Variable loads

- Shock loads (suddenly)

- Impact loads (applied with some velocity)

- Stress and strain (Tensile, compressive, shear)

- Thermal stresses

- Torsional stresses

- Bending stress

Important considerations in Machine Design.....

2. **KINEMATICS** of the machine (Motion of the parts)

Find the simplest arrangement that would give the most efficient motion that is required.

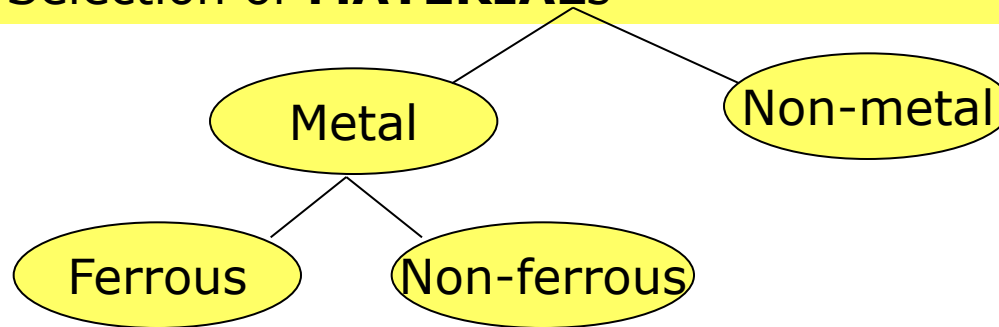
3. Selection of **MATERIALS**

Knowledge of the **properties of the materials** and their **behaviour under working conditions** is required.

Strength, hardness, durability, flexibility, weight, resistance to heat and corrosion, electrical conductivity, machinability, etc.

Important considerations in Machine Design.....

3. Selection of **MATERIALS**



Physical properties: Density, Melting point, Elec/thermal properties

Mechanical properties:

- **STRENGTH** – resist externally applied loads without breaking or yielding
- **STIFFNESS** – resist deformation under stress
- **ELASTICITY** – regain original shape once the force is removed
- **PLASTICITY** – property which retains deformation (required for forging etc)
- **DUCTILITY** – ability to be drawn into a wire by a tensile force
- **BRITTLENESS** – sudden breaking with minimum distortion
- **TOUGHNESS** – resist fracture due to high impact load
- **CREEP** – deformation under stress and high temperature
- **FATIGUE** – ability to withstand cyclic stresses
- **HARDNESS** – resistance to wear, scratching, deformation, machinability etc

Important considerations in Machine Design.....

4. **Form and size** of the parts

Use I-beam or Angle-iron?

The size will be determined by the forces/torques applied (stresses on the object) and the material used such that failure (fracture or deformation) would not occur

General procedure in Machine Design.....

Need or aim

Recognize and specify the problem

Synthesis

Select the mechanism that would give the desired motion and form the basic model with a sketch etc

Analysis of the FORCES

Material selection

Design of elements

Determine the stresses and thereby the sizes of components s.t. failure or deformation does not occur

Modification

Modify sizes to ease construction & reduce overall cost

Detailed drawing

Production

