



MATERIAL SELECTION IN MECHANICAL ENGINEERING DESIGN

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ABSTRACT

This paper includes selection of material according to type of its use in order to follow concurrent engineering. There are so many engineering materials hence there is a formalised process required to select a reliable material for a product. A case study was taken that involved selection of material for design of Go Kart. Material is being selected on the basis to meet critical properties limit such as strength. This process involves better material selection system to help the designer to save time and money on design.

KEYWORDS :

INTRODUCTION

The aim of material selection is the identification of materials which after appropriate manufacturing process will provide the accurate dimensions, shapes and properties at lowest cost.

There are large numbers of materials having different characteristics but poor material selection lead to fail of frame or structural member or to unnecessary cost.

With the advent of the internet, utilization of an online material selection process is a major advancement in the selection of a material for a particular product. The process gives accurate information at fast speeds thus saving time and money during design. The computer can play a major role in storing information (database) on materials properties.

In selection of good material consider the particular design with, better material properties, material cost and availability.

STANDARDS AND CODES

Standards: - A standard is used to set of specification for parts, materials or processes intended to achieve uniformity, specified quality and efficiency. In standards the main cause is that is to place a limit in numbers of items in the specification, so that as to generate a reasonable inventory of sizes, tooling, shapes and varieties

There are many standards like ANSI, API, DIN, ISA, &etc

But ASTM international is an international standard organisations which publishes voluntary consensus for a large range of materials, system, services and products

Here some codes with their full form are given below:-

1.	ANSI	American National standard institute
2.	AISC	American institute of steel construction/ manual of steel construction (M016)
3.	ASM	American society of metals
4.	ASTM	American society for testing and materials
5.	DIN	Deutsches institute for Normung
6.	FCC	FEDERA COMMUNICATION COMMISSION
7.	ISA	Instrument society of America
8.	IS	Indian standard institution

P-ISO code for steel

1- Material group unalloyed steel

2- Material sub grouped for carbon content

Z- Manufacturing process/forged/rolled/cold drawn

AN- Heat treatment

In this, it include the description the description of approach developed by any standards like ANSI, ISO, FCC & etc to assess the economic and social benefits of standards Material, so for P1.Z.AN it's a group of code

The ISO Material provide extensive information on the benefits that standards bring to organisations and more in general, to citizen and society

CODES: - a code has the purpose that it is used to achieve a specified degree of safety performance or quality and efficiency. There is a set of specification for the analysis, manufacture and for making of something

The codes can represent a variety of work piece of material properties and characteristic using a combination of letters and number

For example, P1.2.Z.AN, N1.3.C.AG and stc

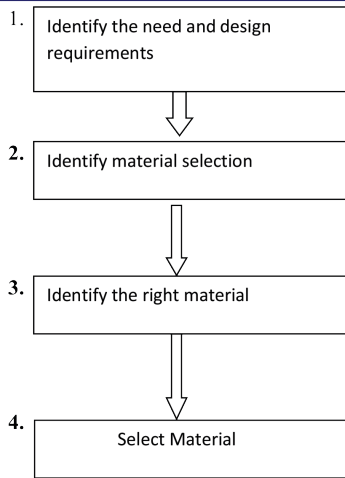
In which one cod defines many things about the material.

SELECTION PROCEDURE

Here we are taken different Procedures in order to selection of material with required properties. The performance, reliability, and cost of any product depend on its components and the joints between components. And the performance, reliability, and cost of components and joints depend on two things:

- 1) Their physical construction
- 2) The materials of which they are made. Physical construction refers to shape and dimensions..

Material selection procedures are:-



IDENTIFY THE DESIGN REQUIREMENTS

In this first to understand the functions of components what to do, what essential condition is supposed to be met? And identify which is supposed to be maximised and minimised.

We are taking an example of Tie rod of Vehicle

Function – Support tensile load

Objective – Minimise mass

Constraints – Required length of load carrying capabilities

Free Variables – Cross-sectional area material

Mass = Area * length * Density

Force / Area < Yields Stress

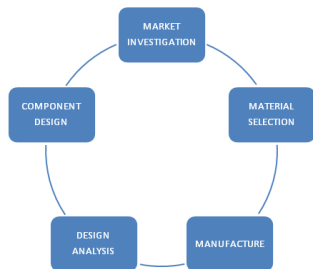
Eliminates free variables

Mass >= (F)(L) (Density / Yield stress)

Therefore minimum weight by maximizing Yield stress / Density

The Design required the following items are:-

- *Performance requirements
- *Reliability requirements
- *Manufacturing and assembly requirements
- *Shape, size and mass requirements
- *Cost requirements
- *Sustainability requirements
- *industry requirements



2. MATERIAL SELECTION CRITERIA

Usually, a problem of material selection involves either selection of materials for new Product or design; or re-evaluation of an existing design/product to increase reliability, reduce cost and improve performance. Materials selection process, being a problemsolving process, is achieved through the following steps:

1. Determination of required critical properties from the design operating Conditions and Environment.

2. Screening of large material database for candidate materials that meet Critical properties determined in steps.

These critical properties can be divided into three groups

A) Non-discriminating parameters are those that must be met if

material is to be used at all. Examples include availability and corrosion resistance.

b) Go/no-go parameters. These are minimum or maximum property values

Which candidate materials must meet. Excess or under values of these fixed

Parameters don't make up for other deficiencies in other properties.

Examples include cost and strength.

Components/Properties	AISI 1018	AISI 1020	AISI 4130
Carbon	0.14-0.20 %	0.17-0.230 %	0.280-0.330%
Density	7.87 g/cm ³	7.87 g/cm ³	7.85 g/cm ³
Tensile Strength	440 MPa	394.72 MPa	560 MPa
Yield Strength	370 MPa	294.74 MPa	460 MPa
Machinability	70%	60 %	70 %

Material selection occurs at every step of design process. At conceptual stage a wider spectrum of materials should be considered to inspire more innovative designs. In the material screening process, material properties considered will depend on possible failure modes likely to be encountered during service, as well as other desired characteristics. By establishing all the possible failure modes for each particular component and matching them with the associated material properties, a list of material properties for the screening process can be established.

c) Discriminating parameters. These are minimum or maximum property values which candidate materials must meet, and where any excess or under values can make up for other deficiencies in other areas. Includes cost, density and strength. Depending on material application, a characteristic that is considered a go/no-go parameter for one application may be considered. For example in aerospace applications cost is a discriminating

Parameters, whereas in consumer products.

We are comparing three materials AISI 1018, AISI 1020 and AISI 4130 with the density, Carbon percentage, Tensile strength, Yield strength and machine ability to get desired material for the project.

3. IDENTIFY OF RIGHT MATERIALS

In this we have identified the number of materials which fulfil our requirement criteria such as-

- a. Weald ability of a material.
- b. Able to bend without fracture.
- c. Easy to available nearby.

4. SELECT MATERIAL

At last select to that material by comparing different parameters as discussed above and use that material in order to successive design and project. For Go-Kart we have selected AISI 1020 as a material for frame design.

CONCLUSION

The study shows very appropriate way of material selection process. There are so many materials but finding better material is difficult. By using process discussed above we have used AISI 1020 as frame material because it has better carbon percentage other than two materials and having less chance of fracture.

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