UNIVERSITY OF EAST SARAJEVO
FACULTY OF MECHANICAL ENGINEERING

THE BASIC PRINCIPE OF DEVELOPMENT OF LIGHTWEIGHT CONSTRUCTION

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WE ARE FROM:
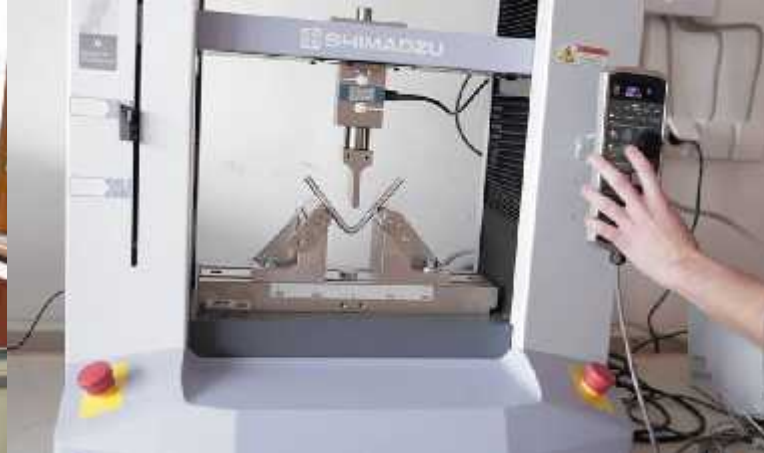**Fculty of Mechanical Engineering,**
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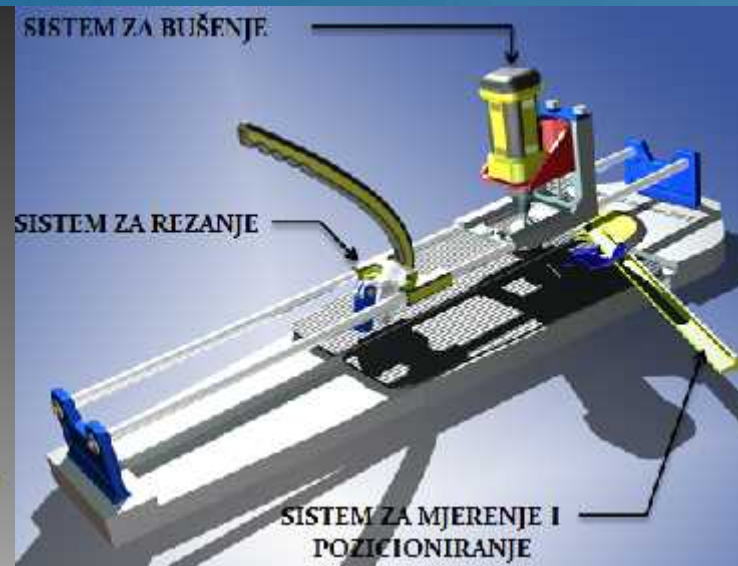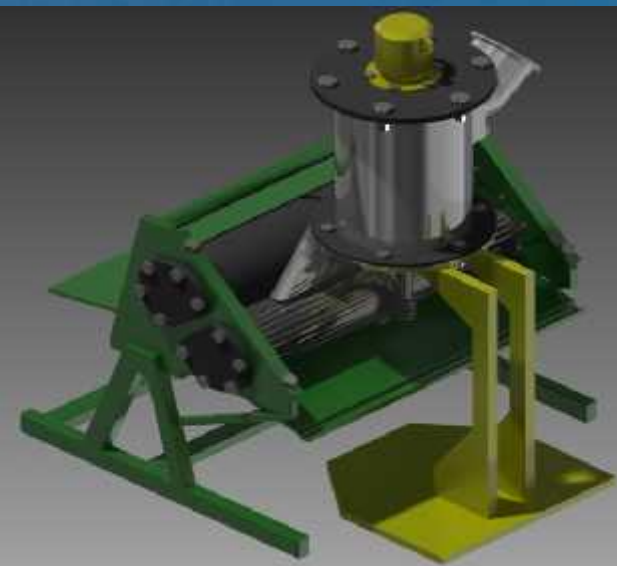
OUR LABS

STUDENTS PROJECT IN PD
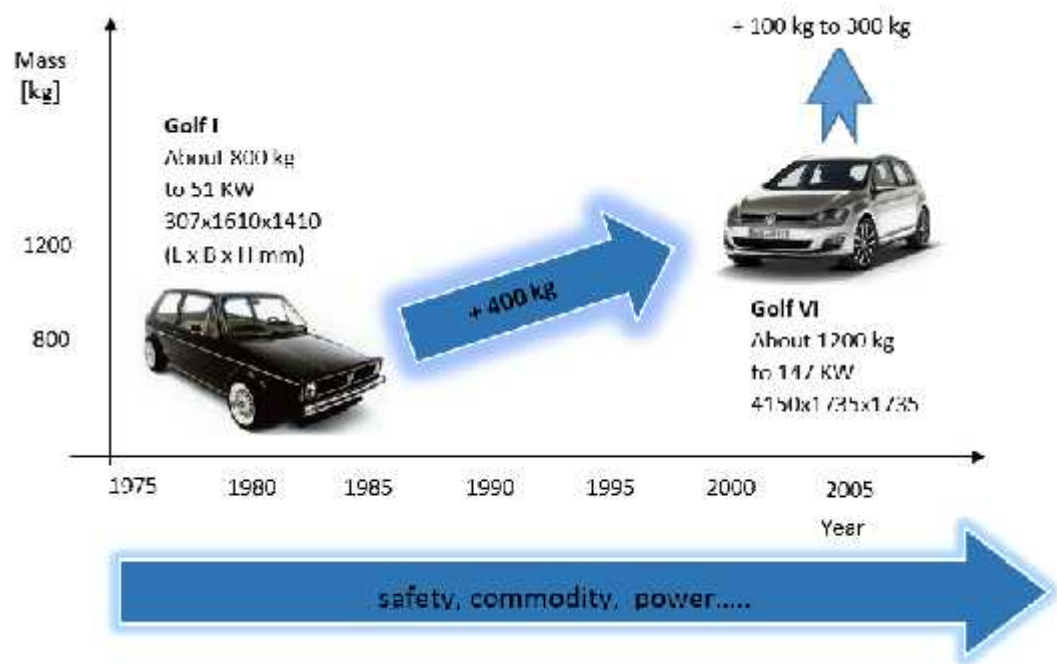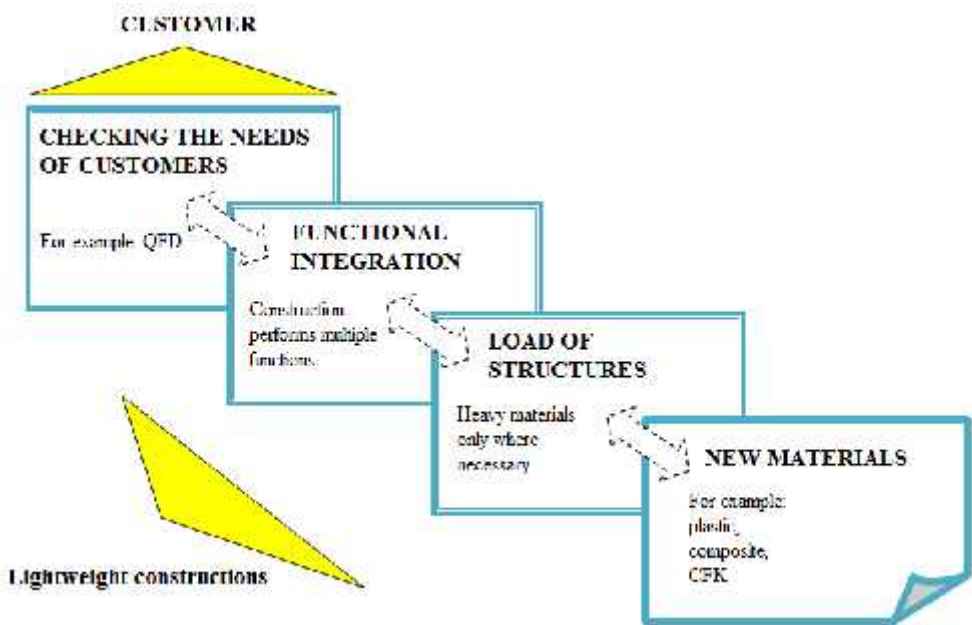
1. INTRODUCTION

- Lightweight constructions (LW) are result of the need for sustainable design and product development. In this way the weight of a single element or the overall construction can be reduced and according to the previously, the degree of utilization of the product can be increased.
- Lightweight design is the key point in terms of competitiveness on the world market.

CUSTOMER

CHECKING THE NEEDS OF CUSTOMERS

For example QFD

FUNCTIONAL INTEGRATION

Construction performs multiple functions.

LOAD OF STRUCTURES

Heavy materials only where necessary

NEW MATERIALS

For example: plastic, composite, CFK

Lightweight constructions

Mass [kg]

+ 100 kg to 300 kg

Golf I
About 800 kg
to 51 KW
307x1610x1410
(L x B x H mm)

1200

800

+ 400 kg

Golf VI
About 1200 kg
to 147 KW
4150x1735x1735

1975   1980   1985   1990   1995   2000   2005

Year

safety, commodity, power.....

2. THE PROCESS OF DEVELOPMENT OF NEW CONSTRUCTIONS

In addition to this basic requirement, in lightweight structures is important the fulfillment of the following requirements:
- safety / reliability,
- adaptability to manufacture,
- suitability for control,
- suitability for assembility,
- maintainability,
- the impact on the environment,
- recycling etc.

Development of lightweight construction

PLANNING
Clarification of boundary conditions
Making a list of demands

Check the realizing possibility

CONCEPT
- Development of principal solutions
- Determination of loads and materials
- Selection of structure, elements and joints
- Approximate previous calculation
- Terms: environment, assembly, manufactory
- Formation and development of conceptual variants

Concept selection

DRAFT – CONSTRUCTION DEVELOPMENT
- Checking loads and operating conditions
- Choice of materials and detailed calculation
- Formation of variant forms
- Making assembly drawing – draft
- Technical and Economic Analysis
- Shape optimization and verification functions

Assembly drawing

MAKING DESIGN DOCUMENTATION
Elaboration of basis for design, drawings, components, instructions

Optimization

Manufacturing and prototyping

Production

3. APPLICATION OF LW DESIGN

4. CRITERIA FOR MATERIAL SELECTION FOR LIGHTWEIGHT CONSTRUCTION

- Weight reduction can be achieved by using lower density materials;
- Important material parameters: physical parameter (density and linear thermal expansion) and mechanical characteristics (tensile strength, yield strength, technical yield strength, modulus of elasticity, Poisson coefficient and impact toughness).

FACTOR LBKz

- Factor LBKz (from German – Leichtbaukennzahl) has been developed for simple and fast comparison of materials that can be used for lightweight structures;
- This factor is dimensionless size which represents the external (F_G) to internal (F_E) loads ratio:
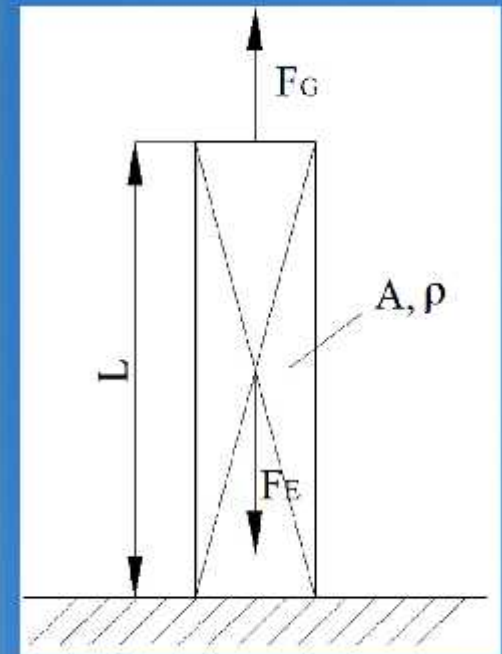
$$LBKz = F_G \big/ F_E$$

- The external load (F_G) is determined on the basis of the following relation:

  $$\dagger = F_G / A \leq R_{eH} \Rightarrow F_G \leq A \cdot R_{eH}$$
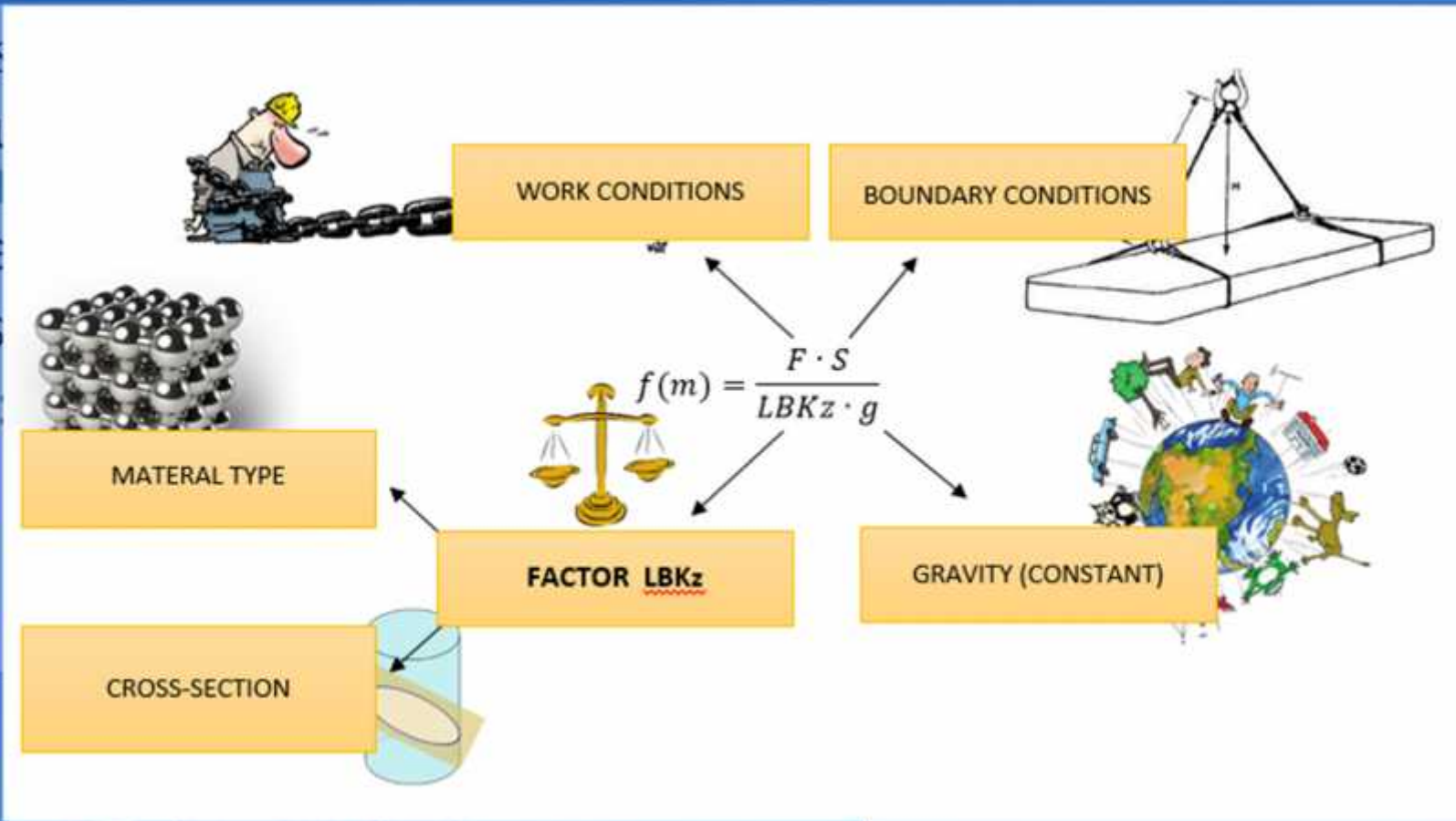
- So, LBKz factor is:
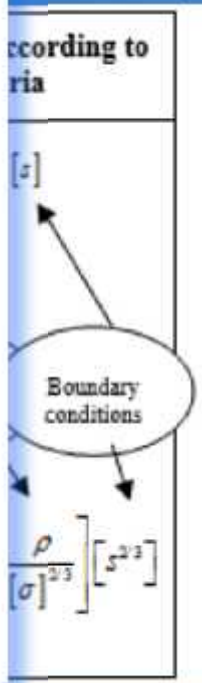
$$LBKz = \frac{R_{eH}}{... \cdot g \cdot l}$$

In case of tension, LKBz factor does not depend on the cross section, but depends of yield strength, density, gravity and length of specimens or parts.

4. DEPENDENCE BETWEEN LIGHTNESS FACTOR LBKZ AND MASS OF MECHANICAL PARTS

- Mas...   ...everal grou...

- Depe...
  mass...
  LBKz:...

WORK CONDITIONS

BOUNDARY CONDITIONS

$$f(m) = \frac{F \cdot S}{LBKz \cdot g}$$

MATERAL TYPE

FACTOR LBKz

GRAVITY (CONSTANT)

CROSS-SECTION

...ccording to ...ria

$[z]$

Boundary conditions

$\frac{\rho}{[\sigma]^{2/3}} \quad [s^{2/3}]$

5. CONCLUSIONS

- The method of development of lightweight construction offers the possibility of obtaining an optimum lightweight structure for use in modern high-quality and market competitive products.
- LBKz factor, expressed as external (F_G) to internal (F_E) loads ratio, has its use value in solving construction dilemmas related to the adequate material selection for defined usage and function of part for the same cross-section;
- When selecting material for a particular group of mechanical parts, LBKz factor can help the constructor to quickly and efficiently make the right decisions, not only in case of lightweight constructions.

THANK YOU FOR YOUR ATENTION!