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Cuprins

STRUCTURAL INTEGRITY DESIGN AND VERIFICATION FOR A SYSTEM HAVING A HEAT PUMP FUNCTION

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SUMMARY: This paper is the first one of a series of research work where will be identified an optimal topology, from a lifetime, cost and thermodynamic point of view, for a device with a principal role of a heat pump. The device itself has a construction similar to hydraulics cylinders. In this paper is presented the general design of the sytem, a work cycle and the first stage of designing, optimising and verifying the integrity of the piston of the first version of the device. The optimisation is realised in Ansys code and consists in a parametric optimisation. The objective function is the reducing of mass, the restrictions consisting in a minimum lifetime of 36600 cycles and a safety coeficient of stability equal or higher than four.

KEY WORDS : Ansys, parametric optimisation, F.E.A., heat pump

1. Introduction

The general subject of this paper is represented by the first stage of optimising the piston of a device with a general function of heat pump, but it is also presented the general design of the device and a work cycle. The purpose of this research is to obtain an optimal topology of the device piston from the mass point of view. This was performed realizing a paramteric optimisation in Ansys code, which has an objective function of reducing the mass, and two restrictions: a minimum lifetime of 36600 cycles and a safety factor of stability equal of higher than four.

2. The general design of the device

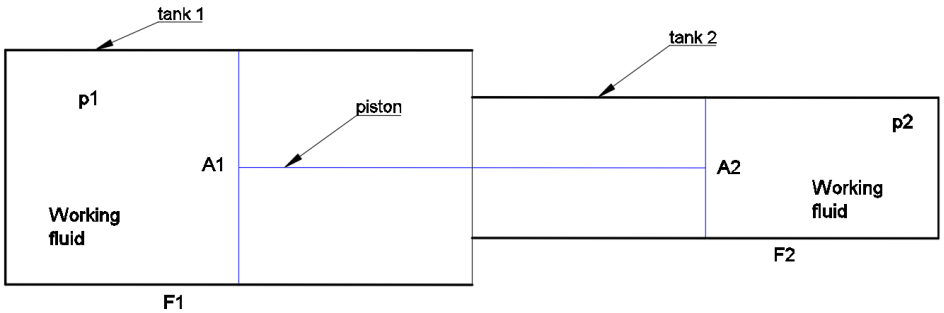

Fig. 1. Sketch of the general design (A – area, p – pressure fluid, F – force)

In Fig. 1. are represented the principal components of the device: two tanks with different diameters, each one of them having a lid who can slide in them. The two lids are rigidized one to another by an element which will be called core. This three part assembly will be called piston. The working fluid is a substance that will constantly have two aggregation states (the gaseous one and the liquid one). This substance is on the liquid curve. In this moment the device is designed and optimised to have carbon dioxide as an working fluid, but once will be idetified an optimal topology for the device, it will be possible to find a working fluid with superior thermodynamic propreties.

3. The work cycle

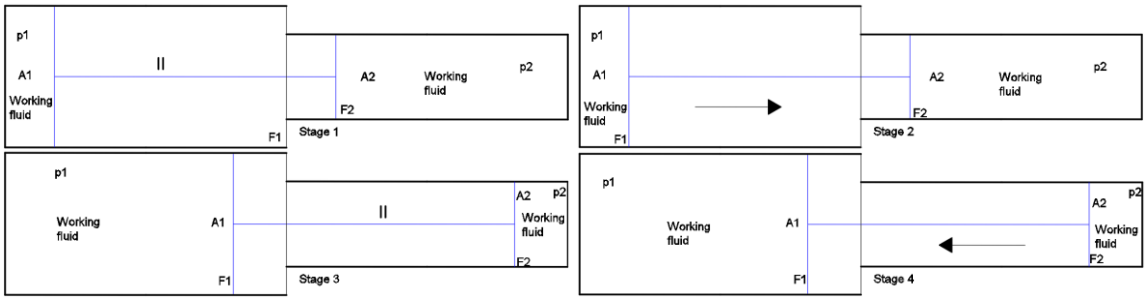

Fig. 2. Four figures collage representing the main stages of the work cycle

In Fig. 2. are represented the stages of the work cycle. Each assembly of tank+lid type is characterized by a pressure and an area, therefore a force. In the first stage, the piston is maintained in the initial position by an external action. In this stage the pressure from the two tanks are equal and defined by the ambiental temperature. The second stage starts once the piston is released, because of the equal pressures of the tanks but also the different areas of the lids a dynamic imbalance occurs witch is producing a movement of the piston in the sens of compression the working fluid from the second tank. This compression is generating the variation of enthalpy on the liquid curve of the carbon dioxide, witch is translated by a heat release. After a period, the piston will stop, this represents the third stage. In the forth stage the piston is returned, by an external action, to its initial place, with the purpose of starting the next cycle.

4. The device topologies that will be designed, optimised and verified to find the best option

In this series of research, to identify a suitable topology for the functional role of such a system and the loads to which is subjected, there will be designed, optimised and verified a variety of topologies.

A topology of system includes predominantly the design and the structural verification of the tank and the piston (including its lids).

Topology classification criteria:

1) By the type of the main degree of freedom:
    a. System with the main degree of freedom of the translation type;
    b. System with the main degree of freedom of the rotation type.
2) According to the perimeter shape of the piston ends (criterion valid only for systems with the main degree of freedom of translation type)
    a. System with circular perimeter of the piston ends;
    b. System with stepped shape of the piston ends.
3) By the number of stiffeners placed between the piston ends (criterion valid only for systems with the main degree of freedom of translation type)
    a. System with 16 stiffeners placed between the piston ends;
    b. System with 12 stiffeners placed between the piston ends;
    c. System with eight stiffeners placed between the piston ends;
    d. System with four stiffeners placed between the piston ends;
    e. System with one stiffener placed between the piston ends (the stiffener is continue on all the circumference of the end of the piston).
4) By the presence of a stiffener plate positioned on the middle of the piston (criterion valid only for systems with the main degree of freedom of translation type)
    a. System with a stiffener plate positioned on the middle of the piston;

b. System without a stiffener plate positioned on the middle of the piston.

In the followings, not all combinations that can result from the upper criterions will be studied. The study will start from one of the possible topologies, after this, using the initial configuration will be compared al the posibilities present at the forth criterion. With the optimal version, will be analised in the same manner all posibilities from the third criterion and the procedure will repeat until it will be identified an overall optimal topology.

5. First topology – general elements

The first topology, according to the criterias mentioned above, is a system with main degree of freedom of the translation type, with circular perimetral shape of the ends of the piston, with 16 stiffeners between the ends of the piston and without a stiffener plate positioned on the middle of the piston.

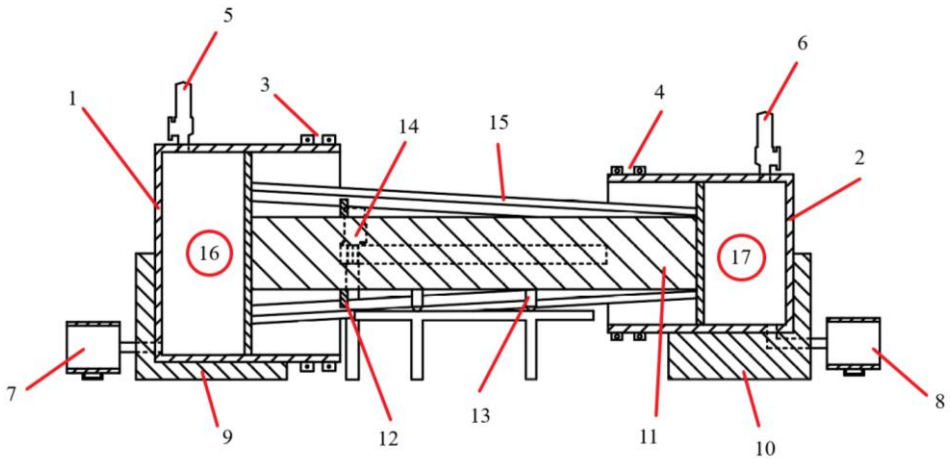

Fig. 3. Sketch of the heat pump with the identification of the main components

Legend: 1, 2 – principal tanks, 3, 4 – stiffening collars of the main tanks, 5, 6 – safety valves, 7, 8 – auxiliary tanks featured with pumps and sense vales, 9, 10 – grounding system, 11 – piston, 12 – stopping element, 13 – the system of ensuring the orientation of the device, represented by guideways (roller supports), 14 – gear electromotor with rack and pinion, 15 – stiffeners of the ends of the piston, 16, 17 – working fluid (represented by carbon dioxide)

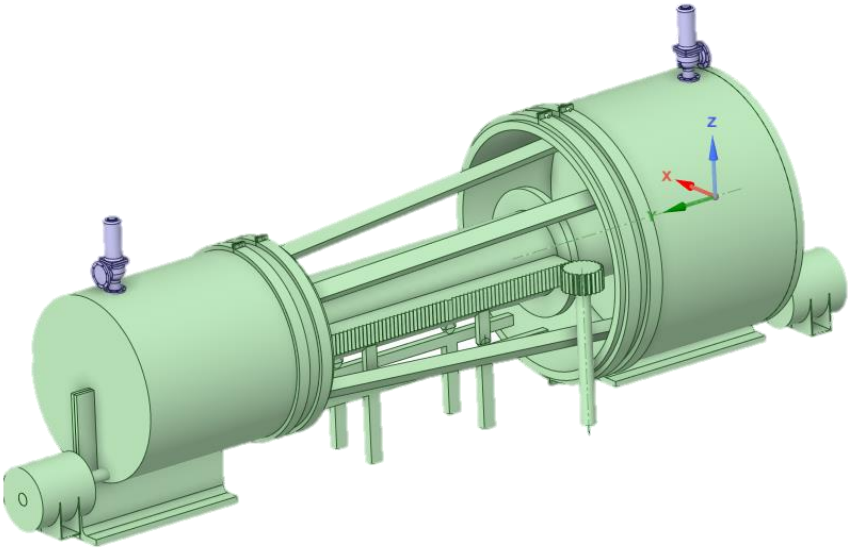

Fig. 4. The 3D model of the first topology approached

6. The optimisation and structural verification of the piston of the first topology

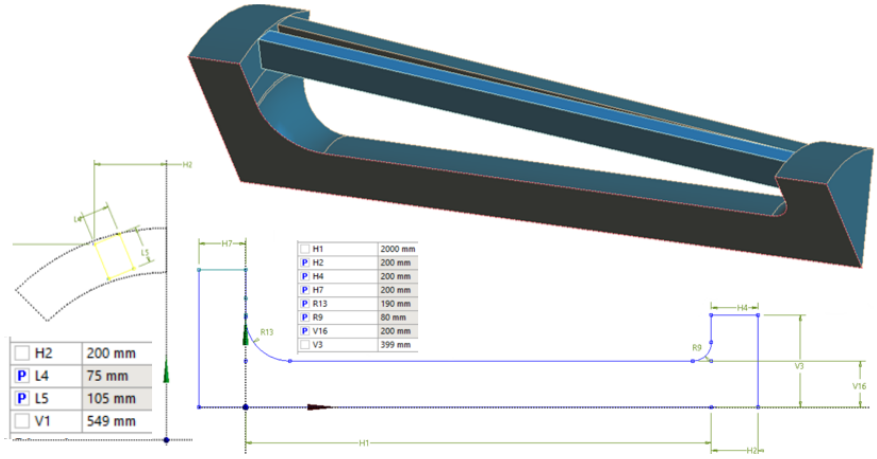

Fig. 5. Collage representing the geometry used to define the finite element model ()

The geometry was made in Design Modeler and not in Space Claim. The advantages of Design modeler are not only the fact that is very clear and easy to set the input parameters for the optimisation analysis (in Space Claim, some of the parameters can be dificult to set), but also, it is posible to create mathematical relations between them, which is what i did to get more control over the geometry. All the elements with a blue "P" in front of them are the input parameters for the optimisation analysis and i preset all the values that they can take during the analysis. The model is representing one eight of the whole piston.

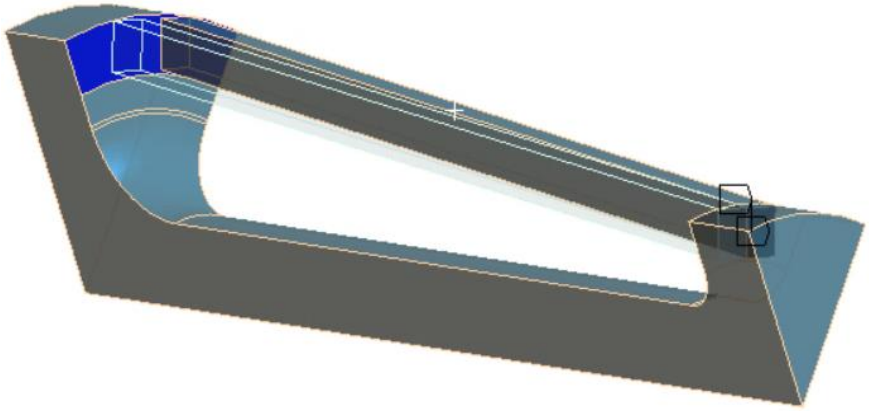

Fig. 6. One of the two defined contacts of "bonded" type, realised between the stiffeners and the edges of the piston

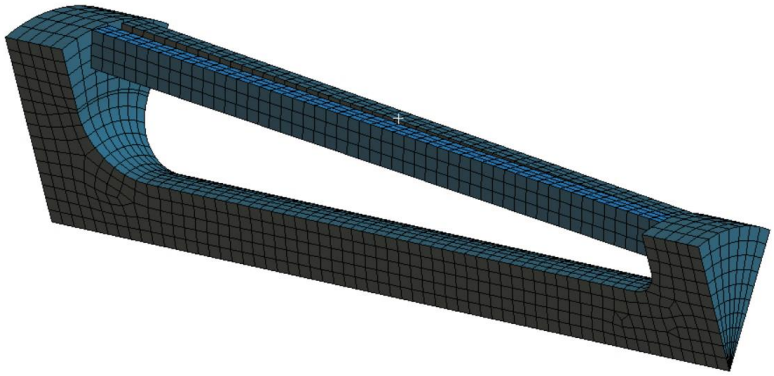

Fig. 7. The controlled (in local and global sizing, mesh method and element order) mesh of the model

The global elelemt sizing is also parametrised, the reasoning will be explained later in this paper.

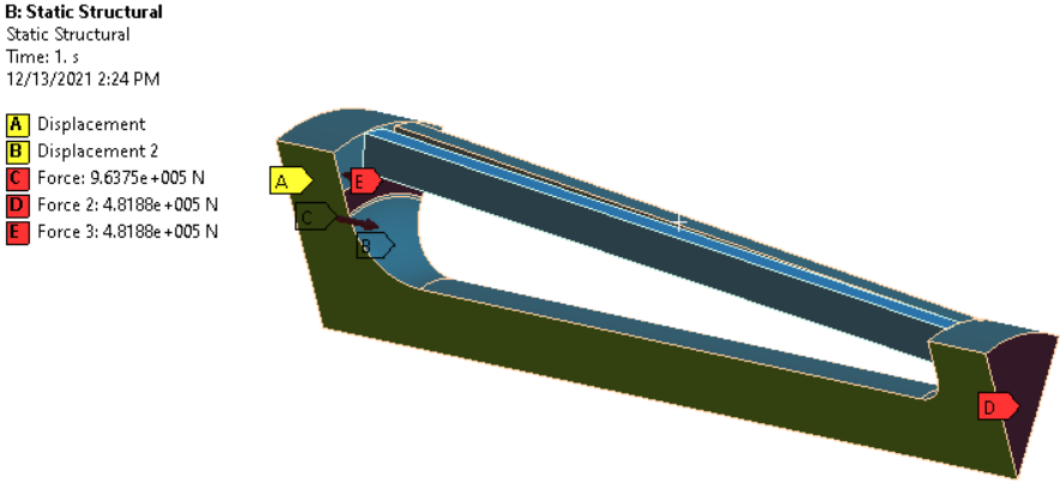

Fig. 8. The boundary conditions (including the loads that appear on the structure)

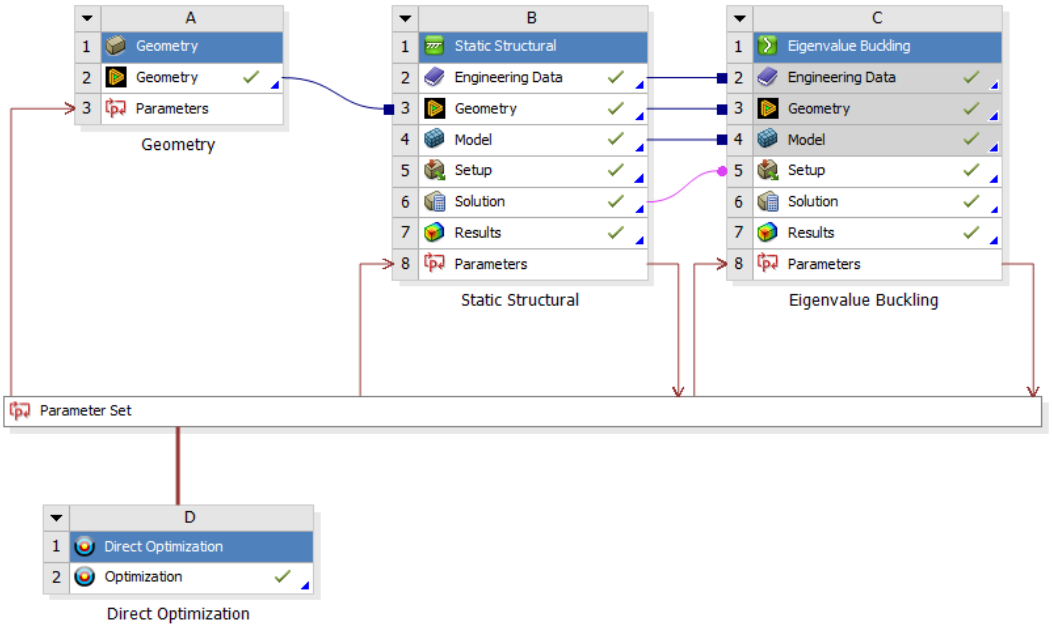

Fig. 9. The optimisation project, including a static model with fatigue calculus and a stability calculus module

The objective function of the optimisation was mass reduction, and it has two restrictions: a minimum lifetime of 36600 cycles and a safety factor of stability equal of higher than four.

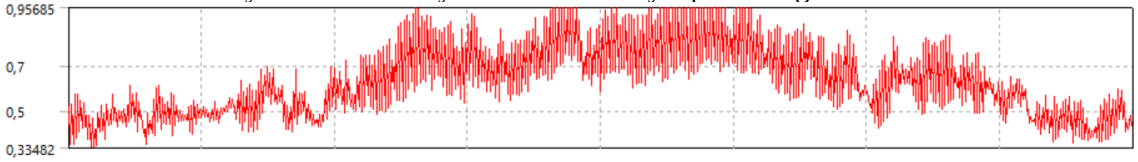

Fig. 10. The graphic representation of the fatigue cycle

The fatigue cycle was defined following the next described procedure. there were obtained daily temperature data with minimum and maximum values for a period of one year from a meteorologic station [3]. There were also imported point from the liquid curve of the carbon dioxide [4]. Because I did not have a continous function to describe the liquid curve I made a program using “C++” language

(Program 1). This program created a one degree polynomial curve between any two consecutive points who are on the liquid curve, after this the program exported as a file with the almost exact pressure that the tank will support at the every temperature received from the meteorological station. The resulted cycle can be saw in the previous figure. It is true that is not possible to know in this stage of the research the aproximative working cycle, but this is not extremely relevant because in this phase only a rought aproximation is needed so, the topologies in the scope of choosing the optimal one, were compared, version which will be further subjected to more realistic working cycles.

For the study of the lifetime it was used the Soderberg mean stress correction theory, which is the most restrictive from Ansys code and its returning a zero lifetime for any zone that have stress over the yield stress.

The optimisation method used was M.O.G.A. and it converged after computing 370 design points. The optimisation had eight input parameters with a total number of permutations of 0.1 bilions which was reduced by the first two inequations that can be seen in the following figure, inequations that also ensure that all the design point will have a geometry that can be generated. The last two inequations that can be saw also in the following figure represent a control in the global element sizing mesh. This is the reason for which it is considered a parameter. Controlling this global element mesh sizing one could obtain design points with simillar accuracy of the resulted stress and also similar accuracy of the loads multiplying coeficient needed to result in an unstable structure. All of the anterior mentioned advantages in the smallest computing time.

P20 <= (200[mm]-P22)+80[mm]	P20	<=	(200[mm]-P22)+80[mm]
P21 <= (200[mm]-P22)+190[mm]	P21	<=	(200[mm]-P22)+190[mm]
1	(P20*P20*(1-3.14/4)*2*3.14*(P20+P22)/2.37+P21*P21*(1-3.14/4)*2*3.14*(P21+P22)/2.37+564.2[mm]*564.2[mm]*3.14*P19+399[mm]*399[mm]*3.14*P17+2000[mm]*3.14*P22*P22)/(8*9000/4)	>=	P33*P33*P33
2	(P20*P20*(1-3.14/4)*2*3.14*(P20+P22)/2.37+P21*P21*(1-3.14/4)*2*3.14*(P21+P22)/2.37+564.2[mm]*564.2[mm]*3.14*P19+399[mm]*399[mm]*3.14*P17+2000[mm]*3.14*P22*P22)/(8*15000/4)	<=	P33*P33*P33

Fig. 11. The constraining inequations used in the optimisation

7. The results of the first phase of the optimisation of the piston of the first designed topology

The results of the Ansys optimisation are presented tabular, following this paragraph, being observed a mass reduction of 70%, percentage not relevant since I intentionally choosed a robust initial model. Other remark consists in the fact that the resulting section of the stffeners of the ends of the piston are similar to the ones obtained analitycally. A final note can be that it is clear that the model can be further optimized. The code in parentheses are for easy understand the mentioned dimmension in Fig. 5.

Table 1. Results from the analysis computed on the initial and on the optimised model

Parameter name	The value for the initial model	The value for the optimised model
Tank two - diameter lid thickness (H4)	200 mm	80 mm
Tank one - diameter lid thickness (H7)	200 mm	80 mm
Tank one – stiffening radius (R13)	190 mm	190 mm
Tank two – stiffening radius (R9)	80 mm	160 mm
Core radius (V16)	200 mm	80 mm
Stiffeners of the lids section width (L4)	75 mm	45 mm
Stiffeners of the lids section lenght (L5)	105 mm	55 mm
Minimum lifetime	2.75e6 cycles	2.75e6 cycles
Equivalent von Mises stress	24,73 MPa	98,54 MPa
Multipliyng loads coeficient	57,25	5,84
One eight of the resulting structure mass	823,15 kg	253,28 kg

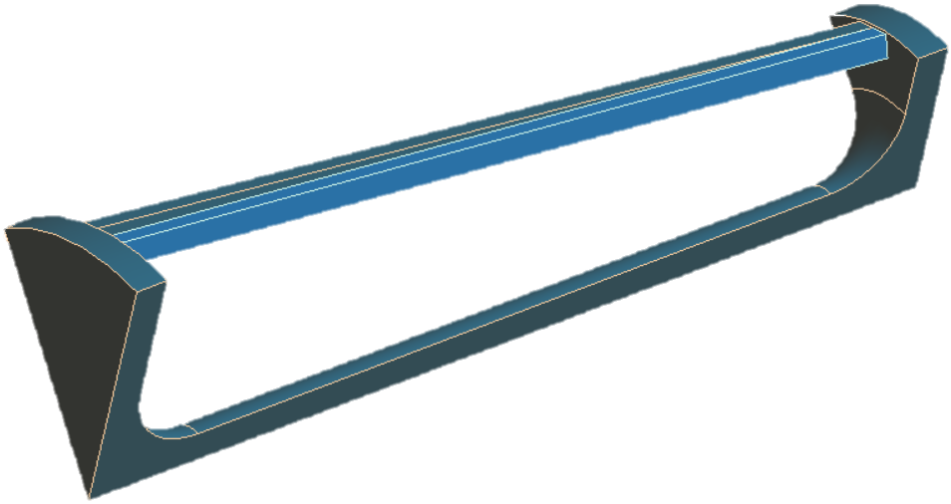

Fig. 12. The geometry of the resulted optimised model

8. Conclusions

In this paper, the first one of a series, the author presented the general design of the device that was conceived and created to be used as a heat pump that uses the ambiental temperature and energy to fulfill this fucntional purpose. It was also presented the work cycle and how this device is functioning. There were also reviewed the topologies that will be compared in time in the scope to identify the optimal one of them.

The design and the first part of the first technology structural piston verification and optimisation was also presented. The optimisation was realised using the parametric optimisation module in Ansys. The optimisation analysis had an objective function of reducing the mass, and two restrictions: a minimum lifetime of 36600 cycles and a safety factor of stability equal of higher than four. The mass reduction between the initial model and the final one was 70%, percentage which is not very relevant fot the moment.

On short term, the next steps will be in the direction of a further optimisation, a manual one this time, of this piston. As it has been mentioned before, from the results table it is easy to observe that the model can be further optimised. In this direction the author already started making some steps. He defined a new program (Program 2) using “C++” language. This program has as the input data all the design point calculated by the optimisation analysis made in Ansys. The program itself identifies all design points who are different by one single input parameter and then is defening a scalar that is representing the ratio between the variation of the mass of the system and the variation of the multipliyng loads coeficient to make the structure unstable, after this for all the ratios generatated by the same input parameter is defined the arithmetic average, which is a measurment of the sensibility. Using all the data generated by this program i will manually optimise three of the best candidates (with different construction) of the optimisation made in Ansys plus one chosen by me. This will represent the second phase of optimising the piston.

On long term the author will apply the same procedure on different tanks and, after this step, on other topologies with the scope of identification of the optimal verison for these devices.

9. Bibliography

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[2] Ansys - User Guide (14.05.2022)
[3] Meteorologic station who shared the temperature data (14.05.2022)
[4] Thermodynamic propreties of the carbon dioxide (14.05.2022)

Analytical and numerical calculus of the elements of a transmission system

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The project consists in designing, modeling but also checking the elements of a 5-speed transmission system. During this work I set out to make a detailed analysis of the essential principles underlying the design, sizing, verification of strength and stiffness in the case of circular section shafts, used in power transmission (transmission system), the constitutive elements of such a system consisting of straight shafts and gears. The paper contains several ways to identify and verify the values resulting from the calculation in software applications such as MD Solids, but also a finite element analysis performed using the Ansys software.

1. Introduction

This study aims to perform a detailed analysis of the essential principles underlying the design, sizing, strength and stiffness testing in the case of circular section shafts, used in power transmission (transmission system), presentation of components for a transmission system, composition such as a system consisting of straight shafts and gears, the analytical and numerical calculation of the constituent elements.

2. Design of components [3], [4], [5]

The constitutive elements of a transmission system are: the protection shield, the input shaft, the intermediate shaft, the output shaft and the gears of different diameters.

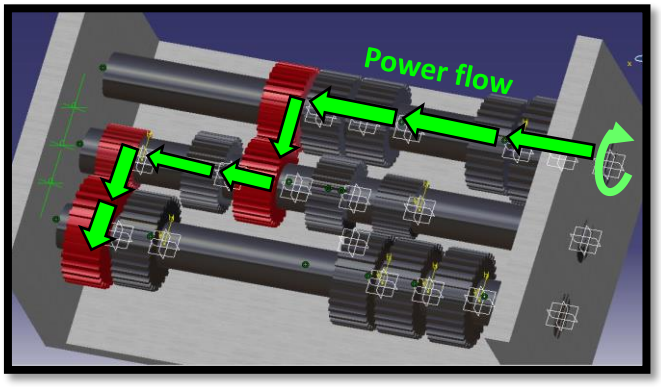

Fig. 1. Set of organological components

After designing and modeling the component elements, the assembly is performed to obtain the final structure of the transmission system, following the analytical and numerical calculation of the elements in the system. For example, the stress that occurs in shafts with a diameter of 40 mm is produced by a torque, and the maximum stress in the system is identified on the output shaft of the first gear (shaft 3).

In Fig. 1 it is shown the concept of the transmission system developed in the CATIA software. Also in this figure it was represented the concept of transmitting the power flow generated by the engine on the first gear.

In addition to the above, one can observe details of modeling and design of gears.

As a prelude to the 2D design and transformation (modeling) of three-dimensional gears, it is necessary to pay more attention to the elements defining the main characteristics of these organological components.

Regarding the main characteristics of the gears, some of them are listed below:

- foot circle;
- dividing circle;
- end circle;
- tooth width;
- tooth height;
- tooth profile.

The creation of the 2D sketch starts from the selection of all the previous features.

Fig. 2 shows the dimensioning principle of a single spur gear with a splitting diameter of 60 mm. In this context, the dimensions for the dividing circle, the end circle, the module (distance between 2 homologous points) and the foot circle have been chosen. In the case of the other wheels, this principle presented in Fig. 2.

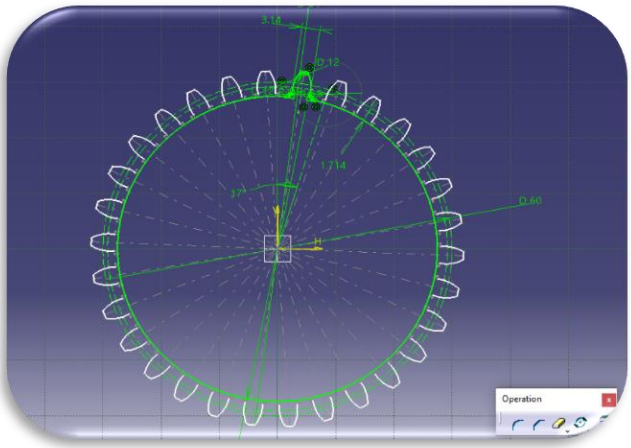

Fig. 2 Dimensioning of the gears.

Fig. 3. shows a solution in three-dimensional format of the gear with a diameter of division equal to 60 mm. To design the 3D model we start from the 2D model (basic model), and by simply using of the commands in CATIA, the complete shape of the gears is achieved. Each spur gear has its own 2D model, the common element occurring on any wheel is the module. This module does not differ, as it is possible to gear and stabilize the system during operation. The module represents the region of the dividing diameter that belongs to a tooth, the range of modules is established by STAS 822-82.

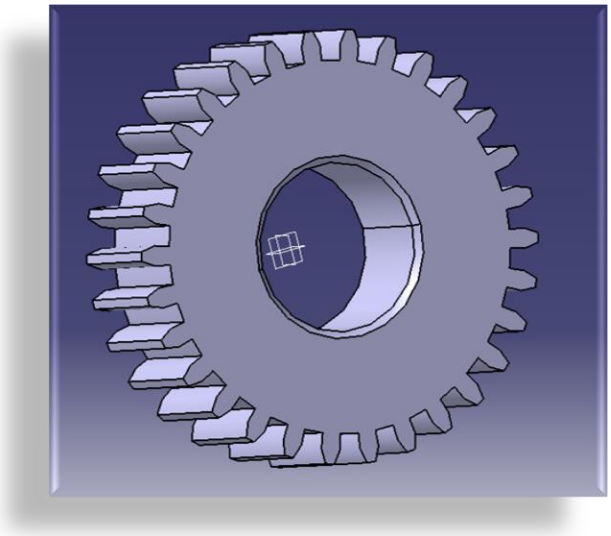

Fig. 3. Modeling wheels in 3D format

3. Analytical calculus of the shaft

In order to be able to perform analytical calculations for all gears, we start from a basic principle, so we made the schematic of the assembly using simple geometric figures

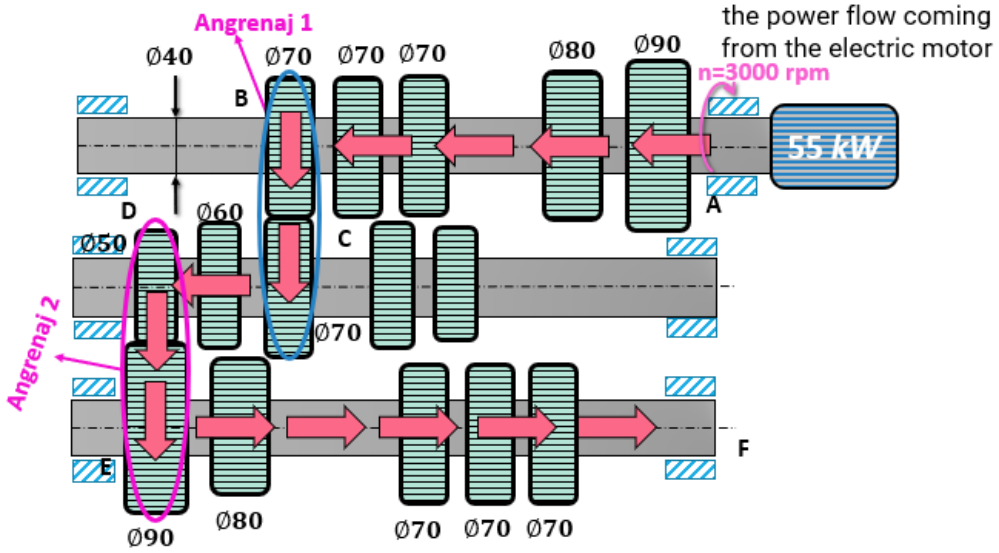

Fig. 4. Schematization of the assembly

Having known: the engine power (P = 55 kW) and the speed where the maximum torque is generated (n = 3000 rpm), it is possible to calculate the torque on the input shaft.

$$M_{tAB} = \frac{30 \cdot P}{n \cdot \pi} = \frac{30 \cdot 55}{3000 \cdot \pi} = 0.1750704\ kNm = 175.0704\ Nm \text{ (1)}$$

$$M_{tAB} = 175.0704\ Nm \text{ (2)}$$

$$M_{tAB} = F_B \cdot 35 \Rightarrow F_B = \frac{M_{tAB}}{35} = \frac{175070.4}{35} = 5002.011428\ N \text{ (3)}$$

$$F_B = 5002.011428\ N \text{ (4)}$$

$$M_{tD} = F_B \cdot 35 = 5002.011428 \cdot 35 = 175.0704\ Nm \text{ (5)}$$

$$M_{tD} = 175.0704\ Nm \text{ (6)}$$

$$F_D \cdot 25 = M_{tCD} \Rightarrow F_D = \frac{M_{tCD}}{25} = \frac{175070.4}{25} = 7002.816\ N \text{ (7)}$$

$$F_D = 7002.816\ N \text{ (8)}$$

$$M_{tEF} = F_D \cdot 45 = 7002.816 \cdot 45 = 315126.72\ Nm \text{ (9)}$$

$$M_{tEF} = 315126.72\ Nm \text{ (10)}$$

$$\tau_{AB} = \frac{M_{tAB}}{W_p}; \text{ where } W_p \text{ is polar modulus (11)}$$

$$W_p = \frac{\pi \cdot d^3}{16};\ W_p = W_{p2} = W_{p3} \text{ (12)}$$

$$\tau_{AB} = \frac{175070.4}{12566.37} = 13.93\ MPa \leq \tau_{a(S235)} \text{ (13)}$$

$\Rightarrow$ the shaft resists to torsional stress

$$\tau_{CD} = \frac{175070.4}{12566.37} = 13.93\ MPa \leq \tau_{a(S235)} \text{(14)}$$

$\Rightarrow$ the shaft resists to torsional stress

$$\tau_{EF} = \frac{315126.72}{12566.37} = 25.08\ MPa \leq \tau_{a(S235)} \text{(15)}$$

$\Rightarrow$ the shaft resists to torsional stress

What we can observe from the analytical calculation in the case of the first gear, is that the torsional stress does not produce destructive effects on the shafts. These organological elements (input, intermediate and output) withstand to torsional stress.

The same relationships and calculation steps are followed to calculate all gears.

4. Transient analysis [1]

4.1 Performing discretization in the case of a gear consisting of two wheels with identical diameters

Discretization is the transition from a continuous structure (with an infinite number of points) to a discrete structure (with a finite number of points) as one can see in Fig. 5.

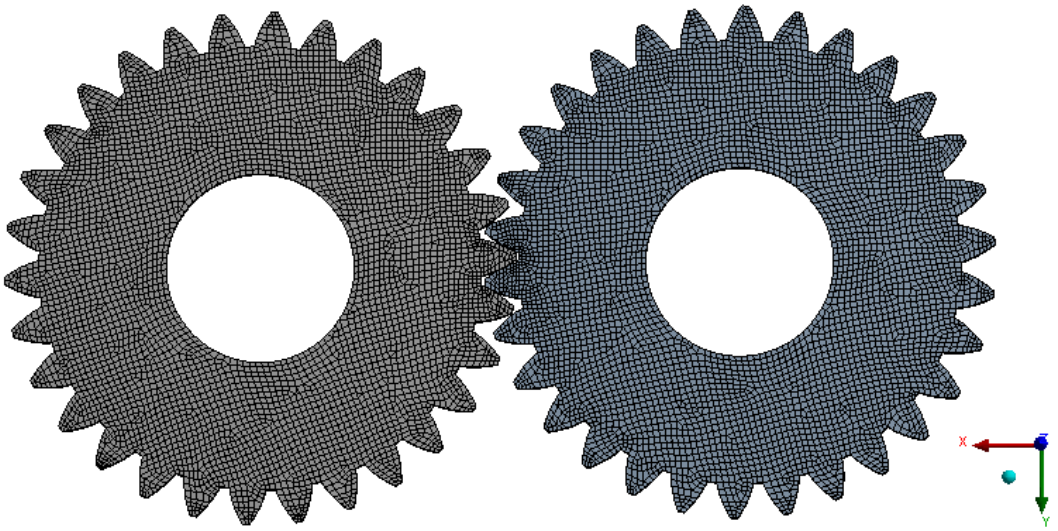

Fig. 5.Discretization

5. The convergence criterion of force

The aim of this analysis is to check if the force that appears in the gear (depending on the iteration) passes under the criterion (represented by the color blue)

This convergence graph is based on the NEWTON-RAPHSON method.

In the graph below, we notice the appearance of several "bisections", these bisections do not affect the analysis in this situation, because at half the time (for the next iteration) the force returns below the convergence criterion. The bisection occurs when there is an imbalance in the system, ie the sum of the forces formed is not equal to the sum of the reactions.

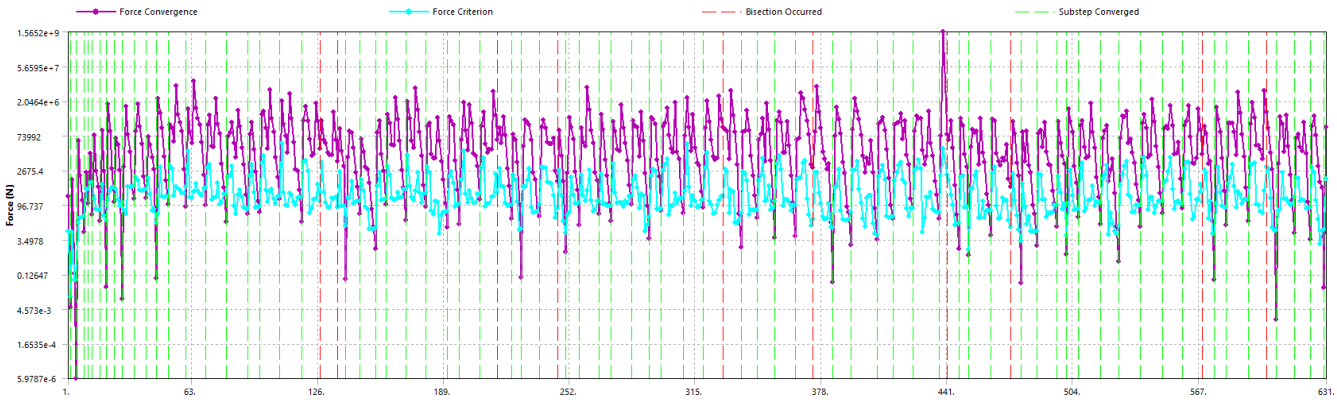

Fig. 6. Graph of convergence of forces

6. Interpretation of the analysis

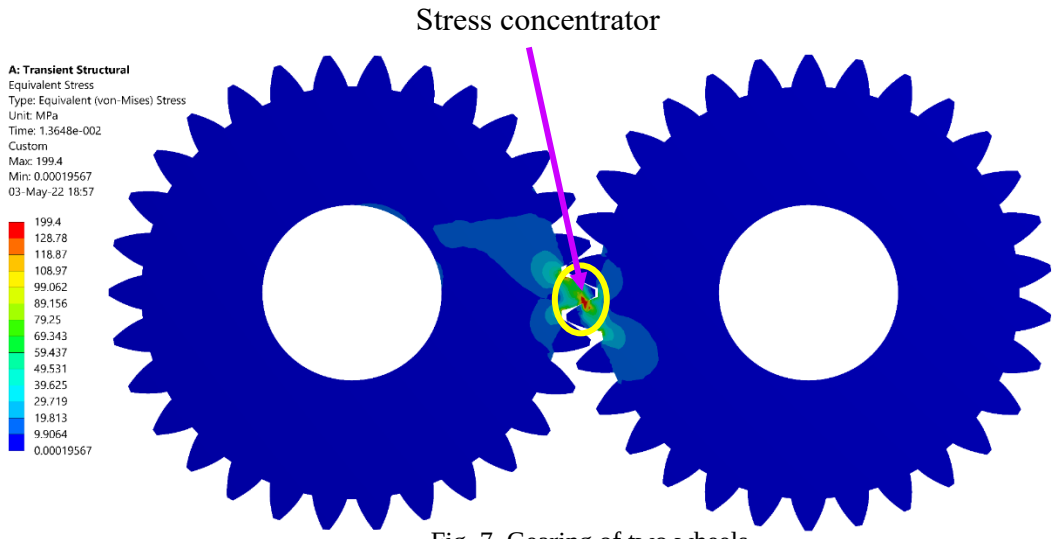

Fig. 7. Gearing of two wheels

Following the experiments performed on the gear in Fig. 7, the maximum value found was 199.4 MPa, in addition to this in the set of output data that the program provides we can find the values for each iteration, these output data can be seen in the graph below.

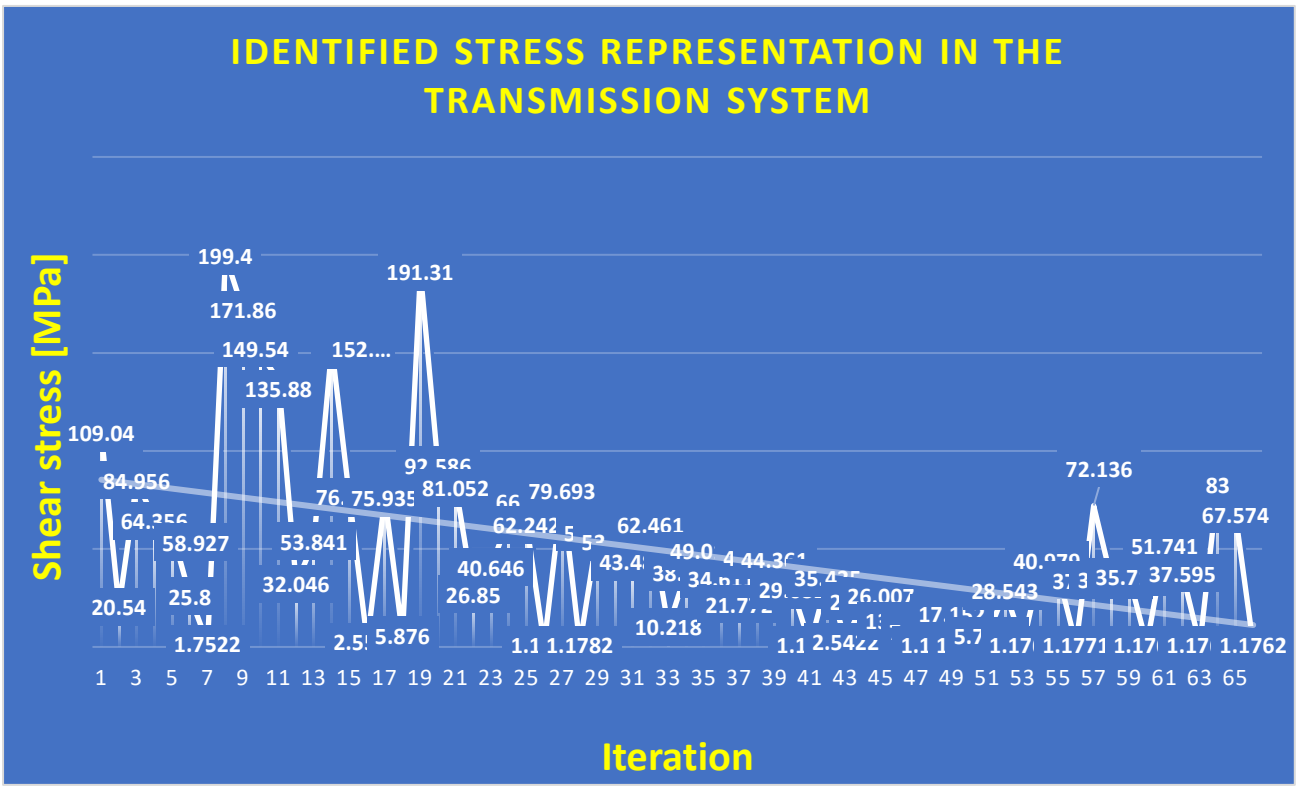

Fig. 8. Shear stress variation

7. Interpretation of output data

The table above is based on the value of the stress on the y-axis, and on the x-axis the time (iteration) where the respective stress is calculated. These values are displayed by the program at the end of the analysis, which can then be processed in EXCEL.

Iterație	Pași de timp	Tensiuni
1	1.00E-04	109.04
2	2.00E-04	20.54
3	3.50E-04	84.956
4	1.42E-03	64.356
5	1.93E-03	58.927
6	3.82E-03	25.8
7	9.80E-03	1.7522
8	1.36E-02	199.4
9	1.94E-02	171.86
10	2.52E-02	149.54
11	3.09E-02	135.88
12	3.67E-02	32.046
13	4.25E-02	53.841
14	5.11E-02	152.86
15	5.98E-02	76.631
16	6.19E-02	2.5503
17	6.41E-02	75.935
18	6.63E-02	5.876
19	6.95E-02	191.31
20	7.44E-02	92.586
21	7.92E-02	81.052
22	8.41E-02	26.85
23	8.90E-02	40.646
24	9.63E-02	66.262
25	9.99E-02	62.242
26	0.10357	1.1804
27	0.10904	79.693
28	0.11178	1.1782
29	0.11452	58.532
30	0.11725	53.752
31	0.11999	43.484
32	0.1241	62.461
33	0.1282	10.218
34	0.13436	38.114
35	0.1436	49.015
36	0.15283	34.611
37	0.15745	21.772
38	0.16207	45.624
39	0.169	44.361
40	0.179	29.032
41	0.184	1.1766
42	0.189	35.425
43	0.1965	2.5422
44	0.204	23.322
45	0.214	26.007
46	0.224	13.142
47	0.2275	7.654
47	0.2275	7.654
48	0.231	1.1761
49	0.23625	17.152
50	0.23887	1.1761
51	0.2415	5.7936
52	0.24412	28.543
53	0.24675	1.1767
54	0.25068	40.979
55	0.25659	37.26
56	0.2625	1.1771
57	0.27136	72.136
58	0.28022	34.135
59	0.28907	35.714
60	0.2935	1.1763
61	0.29793	51.741
62	0.30458	37.595
63	0.3079	1.1761
64	0.31122	83
65	0.31455	67.574
66	0.31953	1.1762

Fig. 9.Centralization of values

8. Equivalent Elastic Strain

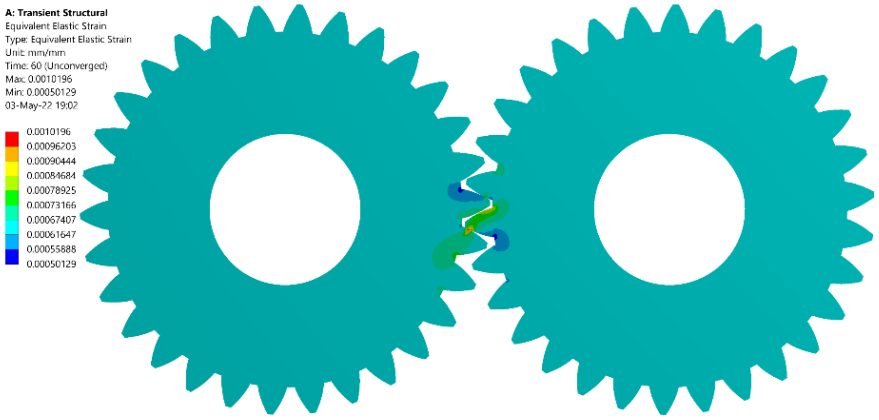

Fig.10 Equivalent elastic strain occured at the teeth contact

From the analysis regarding the strain, we notice that the maximum value is 0.00196 $\frac{mm}{mm}$

9. Shear Stress

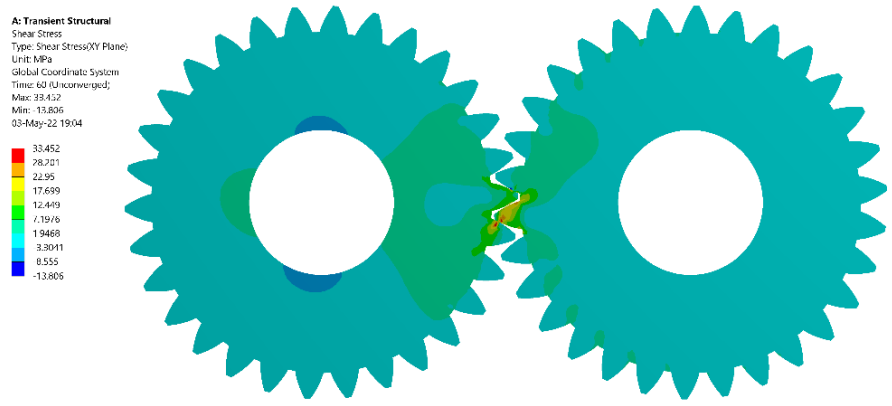

Fig.11 Shear stress occurred at the teeth contact

10. Conclusions

Following the interpretation of the analysis in transient mode, one can argue that the assembly consisting of two gears of identical diameter withstands the stresses occured in the system, the maximum stress at the iteration level (over time) is less than the maximum allowable stress of steel ($\tau_{all} = 220$ MPa).

Due to the numerous tests performed on the principles presented above at the level of gears, using the finite element method (FEM), even if in other gear variants stresses of thousands of MPa could appear (at a few iterations, ex 1000 MPa - 1500 MPa) we cannot draw wrong conclusions, since these local stresses, due to the type of contact between the two gears produce a small pattern contact (Hertzian contact).

Values between 1000 MPa and 1500 MPa are normal because the gears are designed to withstand with such stresses on the sidewalls.

Based on the above, the final conclusion is that the kinematic and dynamic operating conditions of the transmission system are observed, but especially the strength conditions.

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THE STUDY OF A COMPOSITE MATERIAL REINFORCED WITH FLAX FIBERS PUT TO THE CREEP-RECOVERY TEST WITH VARIABLE SHEAR

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SUMMARY: This paper is dedicated to the study of the mechanical behavior of a composite material reinforced with flax fibers with an orientation ±45º with respects to the load direction and symmetrical to the median plane, during a series of 4 creep-recovery tests with variable shear stress. During the entire testing process, a creep period of 1 hour was chosen and for the recovery period a minimum of 24 hours, this being necessary for the strain stabilization of the specimen. After the received information was processed the evolution of strain deformation was further analyzed during all cycles. After the load is removed, the material has the tendency to recover to its original dimension. As the strain deformation is rising on both periods of creep and recovery, this shows us the strain deformation depends on time and that after each recovery period the cumulative plastic deformations takes place.

KEYWORDS: creep, flax, recovery, reinforcement, cumulative.

1. Introduction

In the last decades, the greenhouse effect has become a real problem for humanity and the environment. Different agricultural/transporting activities have been increasing this effect due to different activities that lead to high emissions of carbon dioxide and methane [1].

In the automotive industry, this problem led to finding new solutions to reduce fuel consumption and at the same time, the overall mass of automobiles. The mass reduction could be done by replacing the classic materials (metals, plastic, or glass) with light materials like polymers or composite materials, replacing that lead to a fuel reduction of 16% to 24%. The actual tendency is to raise the renewable resources and promote the green industry, the aim being to replace glass fibers with natural fibers, in this way the reducing mass of automobiles can be done. In comparison, the flax fiber has a density of 1.5 g/cm^3, considerably lower than the density of glass fiber, which is 2.5 g/cm^3. The utilization of natural fibers was increased in the automotive industry for non-structural and semi-structural applications, some retailers are using them for manufacturing different parts such as car seats, sound insulation panels, and linings [2].

This paper is aimed at composite materials reinforced with flax fibers. These fibers have been used in Europe for decades, centuries even in certain industries. These fibers have big potential, all studies done until now do not clarify significant number of aspects regarding the behavior of these composites. Most of the studies presented in the literature are for composites reinforced with flax fibers orientated at 0° or 90° with respects to the load direction, the orientation at ±45° being insufficiently researched to provide the potential of this material.

2. Current stage

This paper is concentrated on the study of a composite material reinforced with flax fibers symmetrically orientated at ±45° with respects to the median plane of the material, subject to a series of creep-recovery tests with variable shear stress. A creep period of 1 hour was chosen and for the recovery period a minimum of 24 hours. This test was performed at the Department of Strength of Materials, University POLITEHNICA Bucharest.

3. Creep-recovery testing

The creep represents the strain variation in time, in which the material is subjected to continuous stress [3]. The recovery from creep represents the decrease of the deformation after removing the load applied during creep [4].

The tested composite material is found in the literature under the name of „angle-ply" due to the symmetrical orientation of the reinforcing fibers at ±45° against the median plane, the reinforcing angle being alternating and different from 0° and 90° [5].

3.1. Method and machinery

A test bench with a double lever mechanism was used for loading during testing, shown in Fig. 3.1, on which a force cell was mounted, shown in Fig. 3.2, and a data acquisition box was used for recording the experimental data, shown in Fig. 3.3.

The machine used for testing is a test bench with levers, with an amplification factor of 26, shown in Fig. 3.1. His components are: 1 – jack to facilitate the application of weights; 2 – counterweight for force balancing in the unloaded position; 3 – levers: 4 – force cell; 5 – grips; 6 – upper tank adjustment crank; 7 – pan.

The load cell is a transducer that converts force into a measurable electrical output [6]. The load cell used, shown in Fig. 3.2, is dedicated to measuring the tensile and compression force up to 20kN. In the load cell is a calibrated elastic element mounted with four strain gauges, two for tensile and two for compression mounted in a Wheatstone bridge, in this way the membrane and strain gauges are elastically deformed by the force applied on one of the two measuring directions [7].

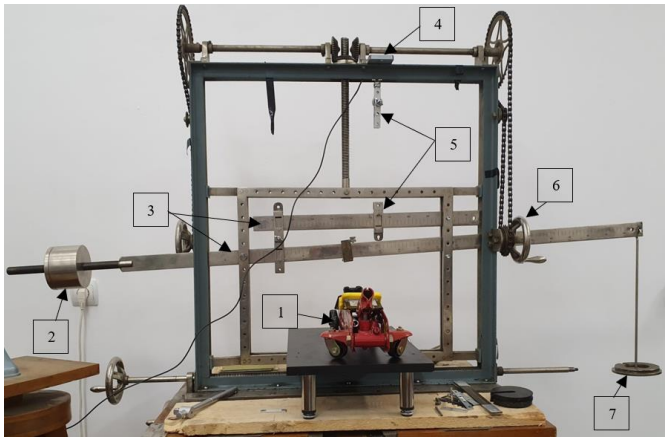

Fig. 3.1 Test bench with levers


Fig. 3.2 Load cell

The method used during the experiment is resistive tensiometry for strain recording. A specimen was mounted on the test bench, equipped with aluminum plates on each end for facilitating the mounting procedure, with two strain gauges for the measuring directions (longitudinal and transverse), along with a dummy specimen used for eliminating compensating possible errors that can appear due to bending, or environmental factors, such as temperature and humidity.

The load cell and the two test bars are connected to the data acquisition system HBM MX840B, shown in Fig. 3.3, connected to a computer for the transmission and recording of the force and deformation using the following 3 channels: channel 1 is used for recording the data from the load cell, channel 2 for recording the longitudinal strain and channel 3 for the transverse strain.

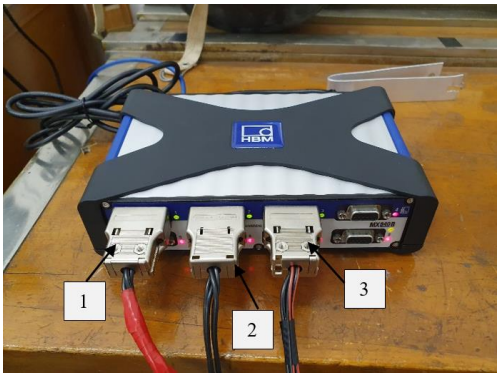

Fig. 3.3 Data acquisition system HBM MX840B

3.2. Preparation and testing

Preparation of the test bars was done by mounting the strain gauges for each direction (longitudinal and transverse). The mounting was done using the following steps: drawing of guidelines for accurate strain gauge positioning, cleaning of the surface with acetone, and gluing them using a cyanoacrylate adhesive. The adhesive was left to dry for at least 24 hours.

After this period, soldering terminals were attached, on which the wires connected to the data acquisition system were welded. This was done to ensure that any improper management of the wires would not pull on the strain gauges directly and to avoid breaking them.

The correlation of the homologous strain gauges found on the two specimens (test and dummy) was done by connecting the wires so the longitudinal direction from each test bar is identical, as well as the transverse direction, these being connected in full Wheatstone bridge in the data acquisition system. The Wheatstone bridge is an electric circuit that contains electrical resistance mounted in series and parallel, used for measuring the unknown electrical resistance by balancing two legs of the bridge circuit [8].

In Fig. 3.4 the test bar dimensions with aluminum plates are presented and in Fig. 3.5 the fully equipped test bar.

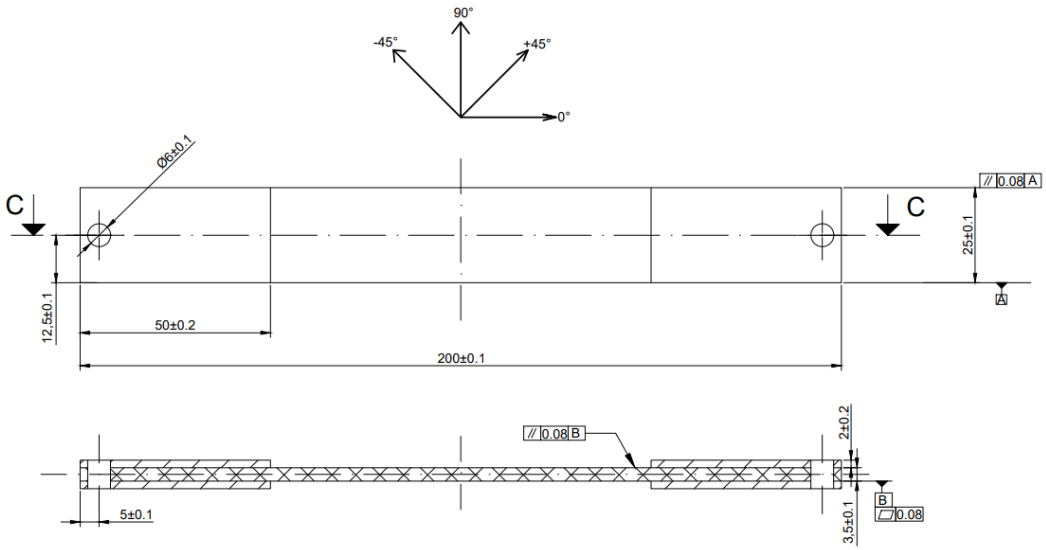

Fig. 3.4 Specimen dimensions

Fig. 3.5 Fully equipped test bar

The test parameters of the 4 cycles are shown in Table 3.1. The test was done at medium humidity of 50% and a laboratory's ambient temperature of 23ºC. A period of 1 hour was chosen for creep and for the recovery period a minimum of 24 hours, this being necessary for the stabilization of the specimen. The creep shear stresses have been chosen based on the shear strain-shear stress curves presented by Stochioiu et al. [10], so that as many cycles as possible can be achieved and failure can be avoided during testing. Obtaining the creep stress was achieved by determining the necessary force developed and amplified by a series of weights, weights that were placed on the plate of the test bench.

Table 3.1 Test parameters

Crt. Nr.	Creep stress τ [MPa]	Force F [N]		Creep period [hours]	Recovery period [hours]	Recording frequency [Hz]	Effective creep stress $\tau_{efectiv}$ [MPa]
		Calculated	Applied				
1	5	811.13	850.15	1	95 ore 35 min	2	5.19
2	10	1622.26	1652.30		24 ore 35 min		10.18
3	15	2433.39	2464.27		44 ore 36 min		15.19
4	20	3244.52	3270		94 ore 55 min		20.15

The effective creep stress was calculated using the relation (3.1) and the applied force using the relation (3.2), obtained from the first relation [9].

$$\tau_{12} = \frac{F_i}{2A} \quad (3.1)$$

- where: τ_{12} – shear stress [MPa]; F_i – applied force at „i" moment [N]; A – section area [mm^2], with A=81.11 mm^2.

$$F_i = 2 * A * \tau_{12} \quad (3.2)$$

3.3. Experimental results

During testing, due to the long period, more than 2 million data points were recorded, for the 4 cycles, these being processed using MATLAB R2021b.

Due to the orientation of the flax fibers at ±45º, the determination of the shear strain was made with the relation (3.3) [4].

$$\gamma_{12i} = \varepsilon_{Xi} - \varepsilon_{Yi} \quad (3.3)$$

- where: γ_{12i} – strain deformation at „i" moment [%]; ε_{Xi}– longitudinal deformation at „i" moment [%]; ε_{Yi} – transverse deformation at „i" moment [%] [4].

After the data was processed, the evolution chart of shear strain γ on the entire testing period was made and shown in Fig. 3.6. Can be seen that the strain deformation has a time dependency, this being confirmed by the testing done by Stochioiu et al. [10].

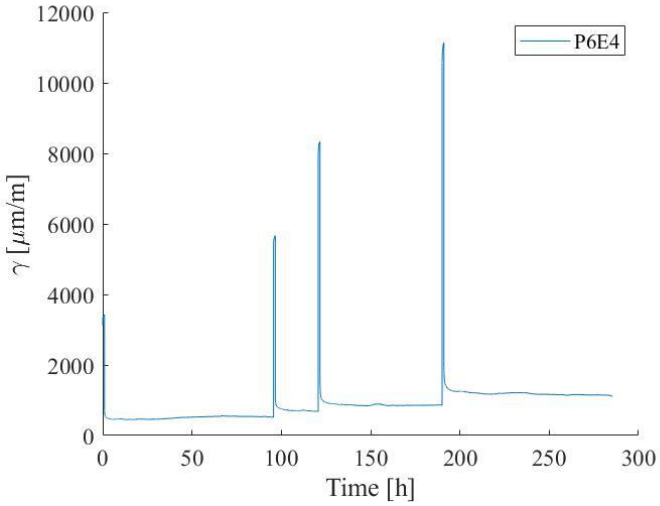

Fig. 3.6 Strain deformation during testing

From the signal, the creep period (see Fig. 3.7) and the recovery period (see Fig. 3.8) have been extracted. During the creep period, the evolution of strain deformation confirms the time dependency and the range of values is similar to the one during the mechanical characterization done by Stochioiu et al. [10].

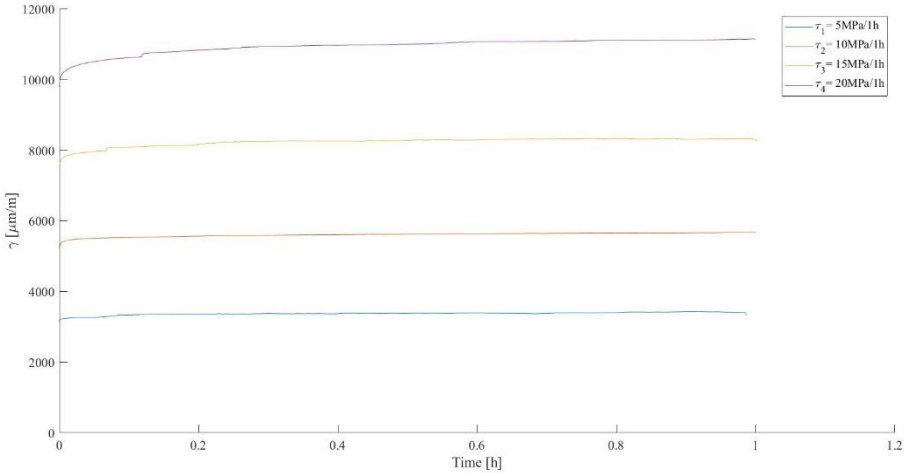

Fig. 3.7 Strain deformation during creep

The tendency of the material to return to its original form can be seen in Fig. 3.8, but taking into consideration that, during the recovery period the specimen is not loaded and the strain deformations are increasing, can be concluded that they are form during the creep periods and they are constant during recovery periods. This is possible due to the sliding of microfibrils and their tendency to progressive alignment with the load direction, leading to plastic deformations, this being a characteristic of viscoelastoplastic behavior [11].

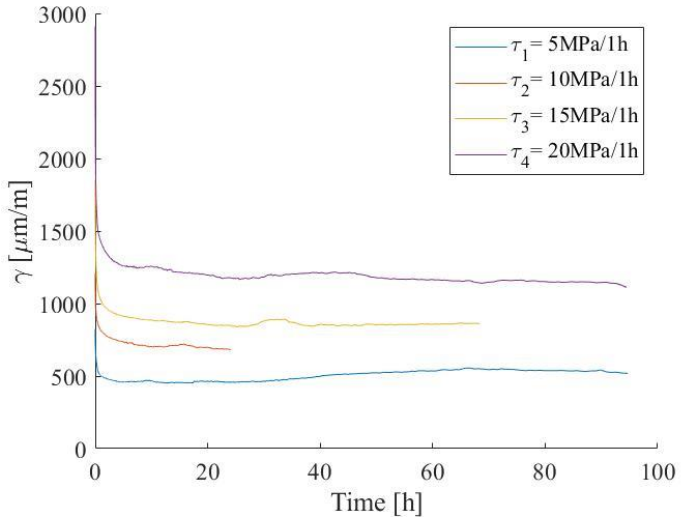

Fig. 3.8 Strain deformation during recovery

As was mentioned, at the end of all recovery periods, plastic deformations are present. They have been extracted and shown in Fig. 3.9. The chart's abscissa was done using the values of creep shear stress, at logarithmic scale, and chart's ordinate was done using the values obtained for plastic deformations, at linear scale so the linear evolution can be observed. Their presence confirms the time dependency of the strain deformations.

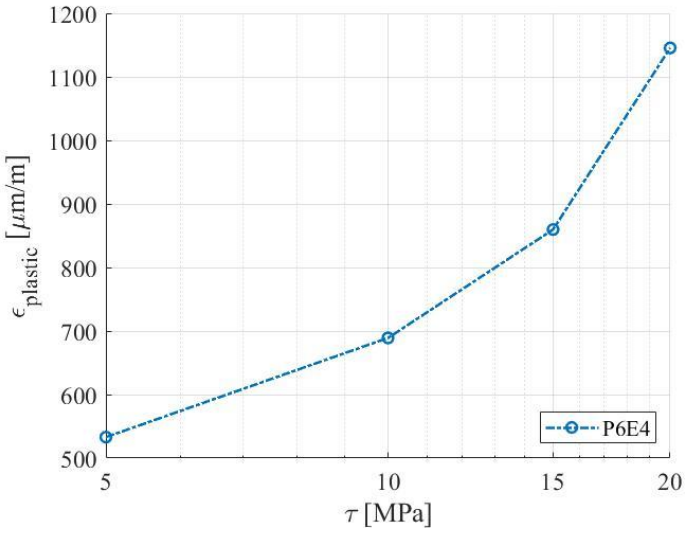

Fig. 3.9 Cumulative plastic deformations

4. Conclusions

In this paper was done and presented the study of the mechanical behavior of a composite material reinforced with flax fibers symmetrically orientated at ±45° along the median plane. This material was subject to a series of 4 creep-recovery tests with variable shear. During the entire testing process, a creep period of 1 hour was chosen and for the recovery period a minimum of 24 hours, this being necessary for the stabilization of the test bar, the test is done at the laboratory's ambient temperature of 23ºC and medium humidity of 50%.

After the test was done more than 2 million data points were registered with a registration frequency of 2Hz, processed, and rarefied using Matlab R2021b.

Processing the experimental data allowed us to determine and observed the strain deformation evolution during the entire testing, also its time dependency, being extracted the necessary information for observing the mechanical behavior during the creep and recovery periods. So it can be seen that in every creep period a strain deformation is presented as being constant during every recovery period. The material has the tendency to return to its original form after the load is removed, but because of the microfibrils' tendency to slide and rotate along the load direction, the strain deformation from one cycle to another is increasing due to the presence of plastic deformations.

After this observation at the end of each recovery period, the plastic deformations have been extracted, strengthening the argument that the studied composite material has a time-dependent strain deformation and also a viscoelastoplastic behavior.

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PROIECTAREA LONJERONULUI MG (MG'S WING SPAR DESIGN)

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ABSTRACT: In this paper we aim to create a new and improved spar design adapted to an aircraft that is currently in development. One might ask what is the optimal design for such a task, and might think that there are just a few options to choose from. While there are many possibilities and variations to add to a structural design of an aircraft, they might not be perfectly efficient for every design, thus we created a spar design fitted for our task, which combined 2 of the most already used concepts in this field, that in the end turned out to me more efficient than the classical ones.

1. Introduction

In this paper we analyze new methods to design an aircraft's wing spar (that is currently in development; MG-017). The present project suggests a new type of spar beam, which is shown to be more reliable for economic and structural reasons, being more efficient than those already used by similar aircraft.

The airplane, MG-017 is an Unmanned Air Vehicle (UAV) whose purpose is to transport medical equipment such as blood bags

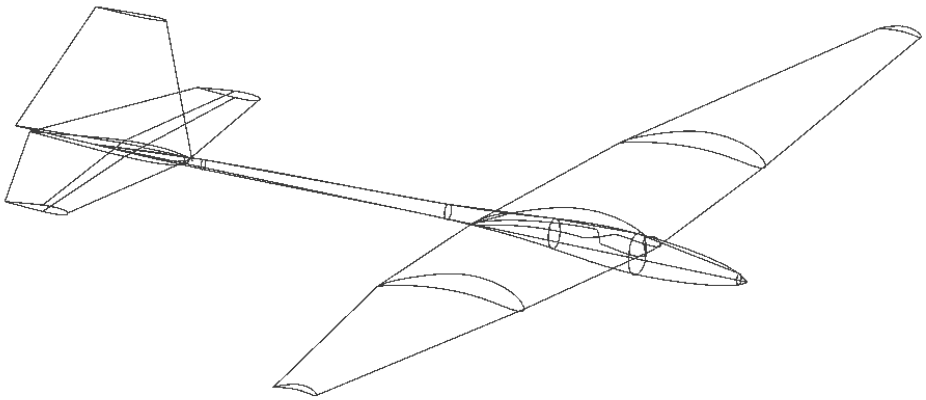

Fig.1 (Representation of the aircraft in the XFLR5 software)

1.2 Aircraft details.

Wing is composed of 3 sections (one central and two adjacent) totaling 1.826m in span, using a dihedral and torsion angle. At the moment it is estimated that the aircraft is going to weight ~3.9kg.

1.3 exposing the problem.

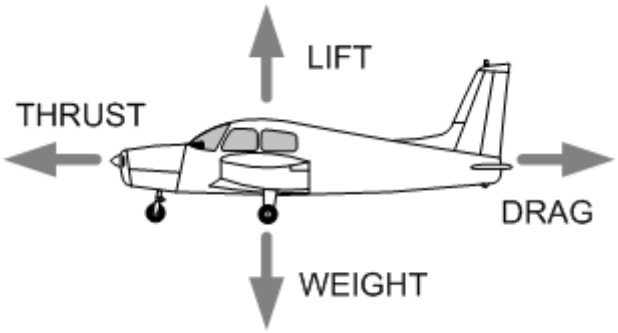

Fig. 2 (The forces acting on the aircraft[1])(http://www.langleyflyingschool.com/)

In various applications, the lifting force of the aircraft is considered to act at a single point (Center of pressure) as well as the forward resistance force. But this is not true, as they are more of a force distributed unevenly along the body that meets the air.

In order to generate more lift and have a more efficient flight, the planes change their angle of attack (the angle between the flight direction and the wind direction), which leads to a higher wing load. So for the study of this aircraft we consider an angle of attack of 7˚ and that it flies at a speed of 9 m / s. We consider relevant only the lift and drag force, summarizing the phenomenon to a problem of compound stresses. Moreover, considering the whole wing as a bar, which is embedded in the area where the fuselage is attached.

1.4 Solving the Problem

The first step in solving the problem is to determine the intensity of the forces acting on the wing, which has been reduced to a bar. For this it is necessary to apply some notions of advanced aerodynamics, such as the Schrenck[2] method from which the local lift force results:

$$p(y) = \rho U_\infty \Gamma(y) \quad \text{[N/m]} \quad (1)$$

$$= \frac{\rho}{2} U_\infty^2 \cdot c C_z(y)$$

$$= \frac{\rho}{2} U_\infty^2 \cdot c(y) C(y)$$

ρ -air density; U -air speed from infinity , c(y)- chord line in that point, C(y) lift coefficient

Similarly, we obtain the local drag force.

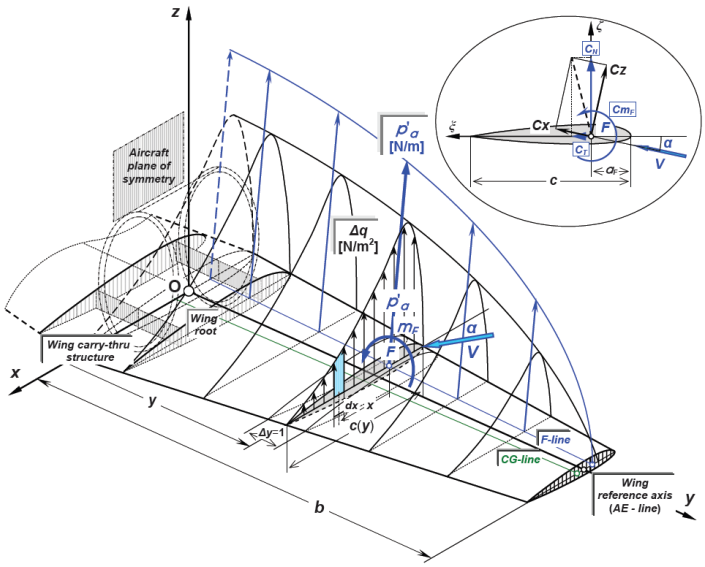

Fig.3 Lift distribution on a wing[3]

Applying the formula mentioned above for as many points on the semi-wing as possible (the problem is symmetrical, so for simplicity we will work only on one side), we obtain the following lift distribution:

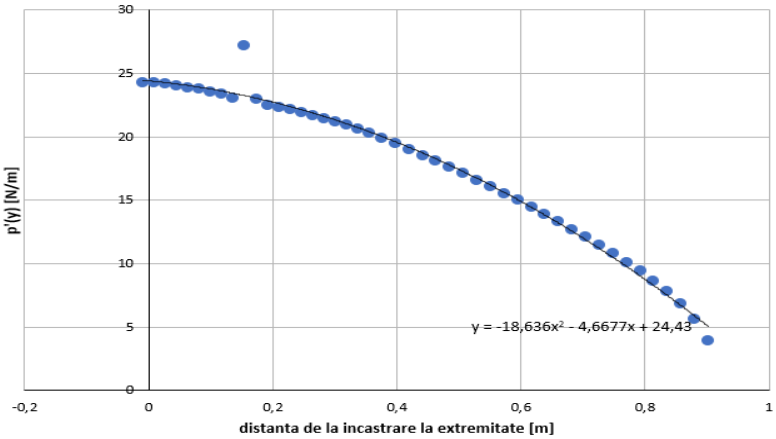

Fig.4 Load distribution on the MG-017 semi-wing

There are points that deviate significantly from the approximation curve, but they occur as a result of extrapolation problems from the polar graphs of the XFLR5 program profile that determined the values c (y) and C (y), on the graph we can also see the function of the ditribution. In the case of forward resistance force distribution, there were many more points that deviated from the curve path, and they had to be changed manually.

We know that the intensity of the force acting on a bar is equal to the area under the curve joining the points of maximum force of the points on the bar that replaces the wing, in our case, to determine the force acting on the wing, we must apply the following relation:

$$T_P(y) = -\int_y^{\frac{b}{2}} f(t)\,dt \text{ [N] (2)}$$

And to determine the moment, we aim to integrate the shear force as follows:

$$M_P(y) = -\int_y^{\frac{b}{2}} Tp(t)\,dt \text{ [Nm] (3)}$$

To get the shear force and moment diagrams, we can put them on a graph as shown here:

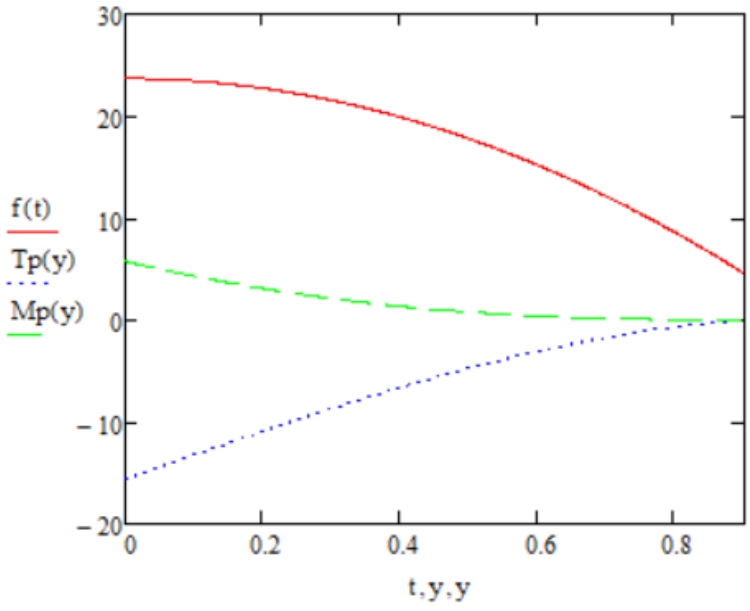

Fig. 5 Shear force and moment diagrams in the case of lift force.

Similarly, the algorithm is executed for the forward resistance force:

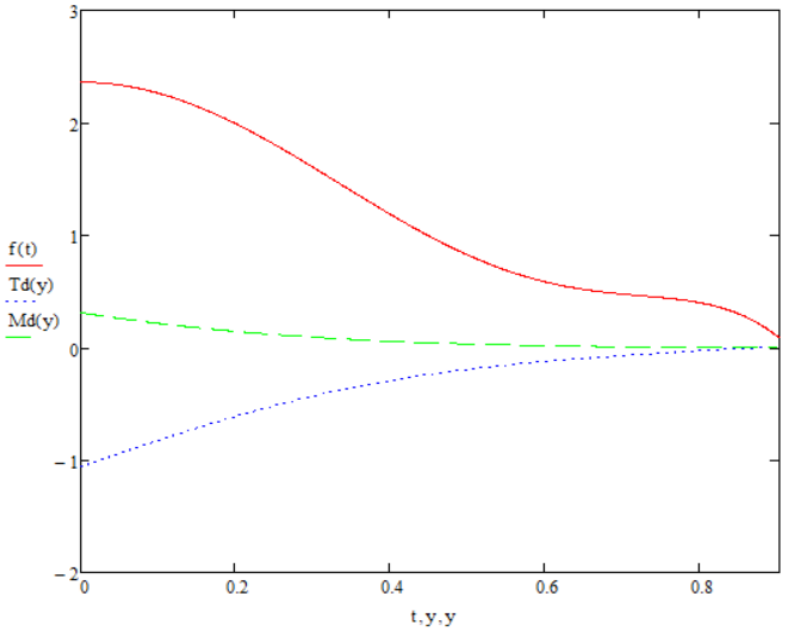

Fig. 6 Shear force and moment diagrams in the case of drag force.

With this data, we can do the pre-sizing calculation of the spar. It is noticed that the critical section is in the embedded region.

1.5 Spar choosing

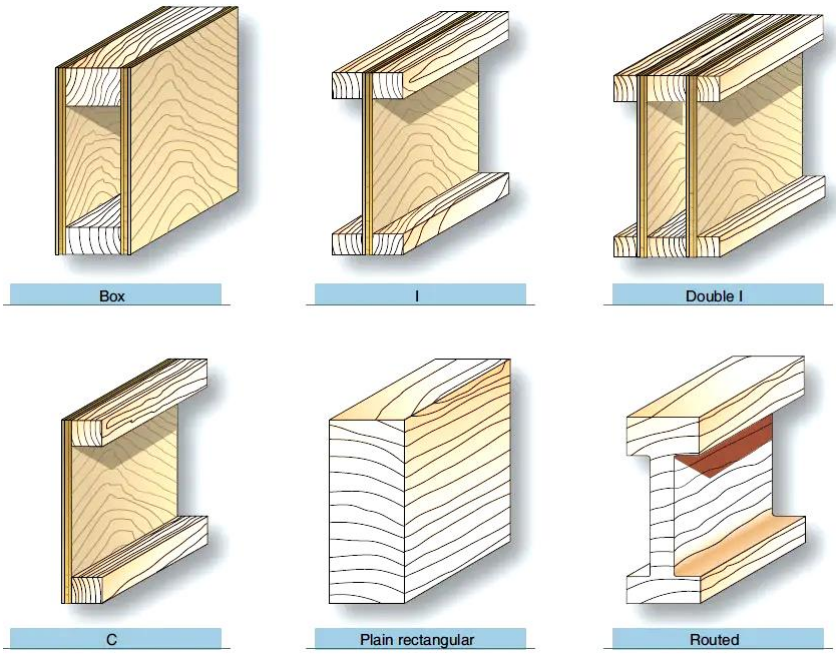

Fig. 7 Models of wing spar designs already used[4].(https://www.aircraftsystemstech.com/2019/05/repair-of-wood-aircraft-components.html)

The innovation that this work brings is the combination of 2 existing spar beam designs. The 'I' and 'Routed' shapes are ideal if we have shear force only vertically, but, as we know from

Chapter 1.3, we also have the forward resistance force, where the ‘C’ shape is the most ideal. Therefore, we wanted to investigate what would happen to the dimensions of the spar if we were to design two ‘I’ shaped beams, one of which would be smaller and arranged at 90˚, as in fig. 8.

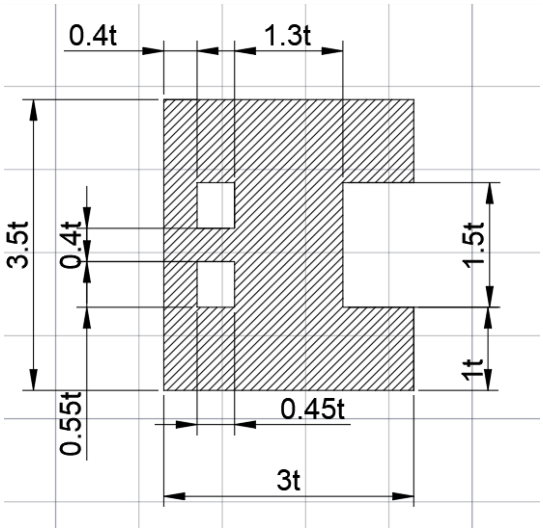

Fig. 8 section for‘ 2IC’ beam

The above piece derives, as mentioned above, from a type ‘I’ shape which we will analyze for comparison, taking the same proportions:

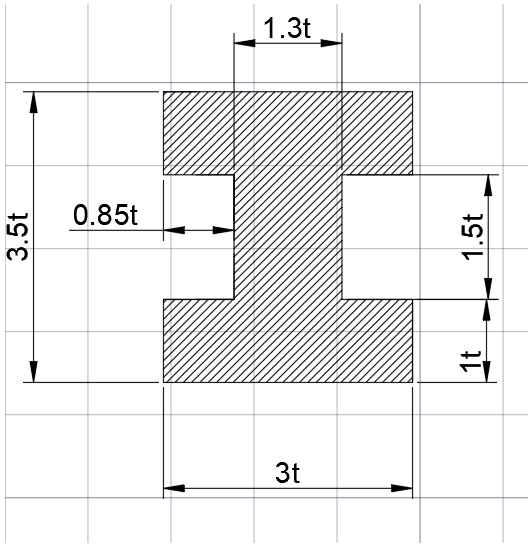

Fig. 9 section for ‘I’ beam.

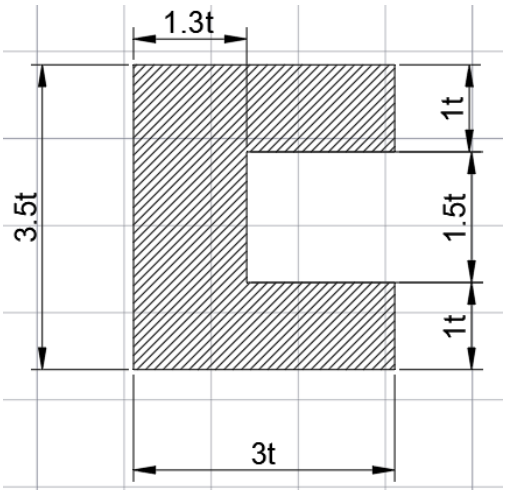

Fig. 10 section for ‘C’ beam.

Based on the data provided by the diagrams and the figures above, we can calculate the stresses in the beams (embedded) with the relation:

$$\sigma = \frac{M_{ech}}{w_y} = \frac{\sqrt{M_P^2 + M_d^2}}{w_y} \quad \text{[MPa]} \ (4)$$

Result that must be less than the maximum allowable tension, which we will consider 70MPA (Balsa, aviation board)

Following the calculations, for the spar ‘2IC’ a tmin = 2.001 mm is obtained, and for the one in the ‘I’ shape, a tmin = 2.41 mm. But these numbers for safety are multiplied by a factor of ‚2.5’. So for ‘2IC’, the t becomes 5.0025 mm and for ‘I’, the t equals 6.025 mm. Performing some volume calculations, it turns out that the ‘2IC’ spar needs 221576.46 mm^3 of material, and the ‘I’ shaped one needs more, 260308mm^3. Performing the calculations analogous to the type 'C', we get that we need 202415 mm^3 of material, but the final calculation must also calculate the fact that in flight there are aerodynamic moments, gusts of wind, phenomena that twist the wing, a process in which the shape ‚2IC’ may hold up better.

2. Current Stage

Currently only the pre-sizing calculations of the spar are completed. In the coming weeks, numerical simulations will be made, analyzing the 3 spars in more detail (the aerodynamic moment will be taken into account, possible twists, etc.), and then one will be chosen, which will lead to the development of the aircraft structure.

3. Conclusions

As shown in Chapter 1.5, the ‘2IC’ shape of the beam, is more efficient because it requires less material, therefore a lower cost and a lower weight. In the following analyzes of this spar, we propose that the ‘2IC’ form be subjected to twists, thus taking into account one more moment, the aerodynamic moment generated by the wing.

4. Bibliography

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NUMERICAL AND EXPERIMENTAL STUDY OF AN AL-PLA SANDWICH BEAM LOADED IN BENDING

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SUMMARY: The purpose of this paper was to highlight the difference between the results obtained experimentally and those numerically obtained with FEM for a sandwich beam loaded in bending. The beam was supported at its ends, a force being applied in the middle spam. Sandwich beams are strength components for larger structures, so it is very important to know their behavior when subjected to various loadings, in this paper being study its behavior in bending.

KEY WORDS: Sandwich beams, experimental results, three-point bending, FEM.

1. Introduction

Sandwich beams are used to strengthen a structure. Some models can also be used in aviation due to their low weight. As they are elements of resistance, it is very important to know how they behave when subjected to bending. The figure below shows the components of such a beam.

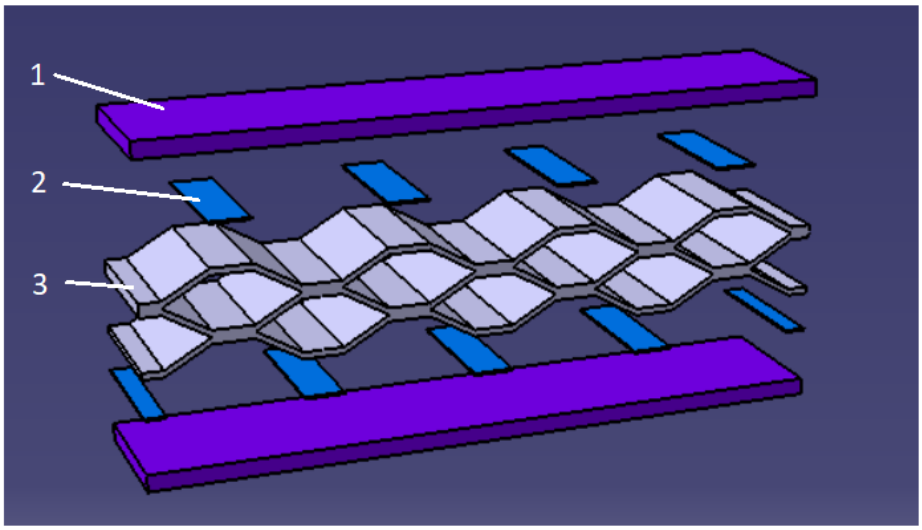

Fig. 1. Beam components

2. Analysis of a sandwich beam in Ansys Workbench

In order to perform the analysis, the material characteristics for each surface must be defined. In figure one it can be seen that three different materials have been defined. The standard aluminum, the adhesive, and the PLA for which Young's modulus, Poisson's ratio, and density were selected.

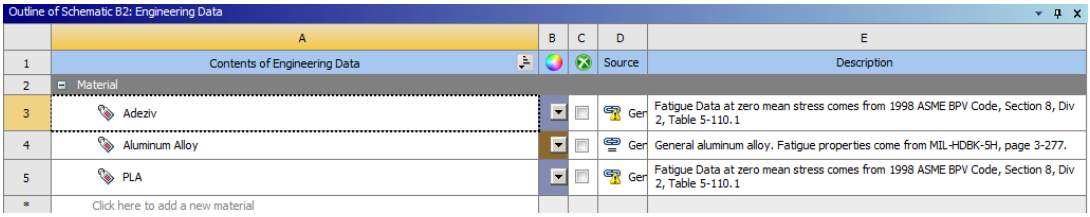

Fig. 2. Defined materials

Table 1. Material characteristics of the sandwich beam

No.	Material	Density [kg/m^3]	Young modulus [MPa]	Poisson's ratio
1.	Aluminum	2770	71000	0.33
2.	Adhesive	1380	3050	0,34
3.	PLA	1400	3200	0,35

Once the materials were defined, the geometry was modeled. It was performed in CATIA V5 and later imported into Ansys. The variant to be used can be seen in Fig.3.

Three planes have been created in Space Claim to apply the supports and movements. These planes are highlighted with indices one, two and three.

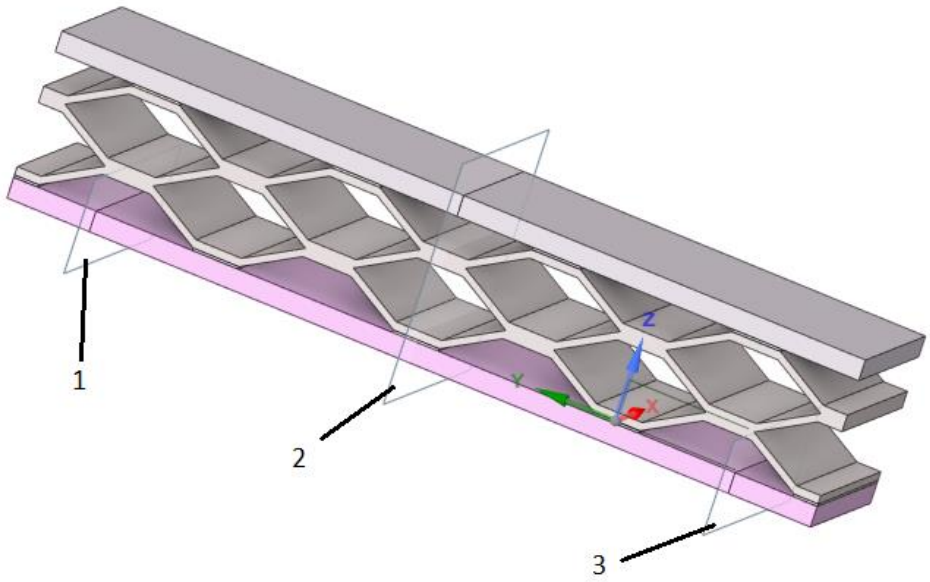

Fig. 3. Geometry and highlighting of the three planes

A controlled discretization was used so that the elements were predominantly quadrilateral and had a size of 1 mm. Due to the appearance of a single element on the thickness of the structure it has been necessary to use the function "Element Order" → "Quadratic". The use of a single element on the thickness of a structure should be avoided as this may influence the results. In Fig. 4 it has been represented the structural mesh.

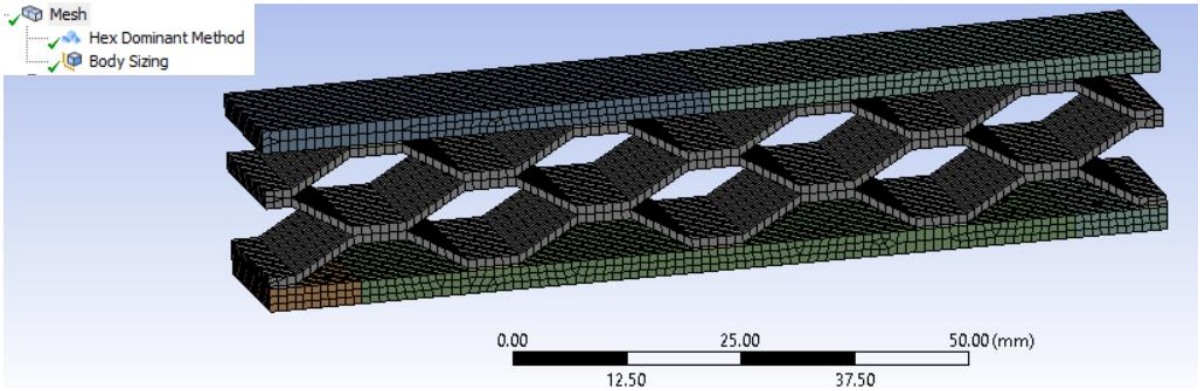

Fig. 4. Structure mesh

The boundary conditions were applied as it can be seen in Fig.5. A 1.88 mm “Displacement” was applied at the top, and a “Displacement” was also applied at the bottom so it will allow the structure to move only along the z axis.

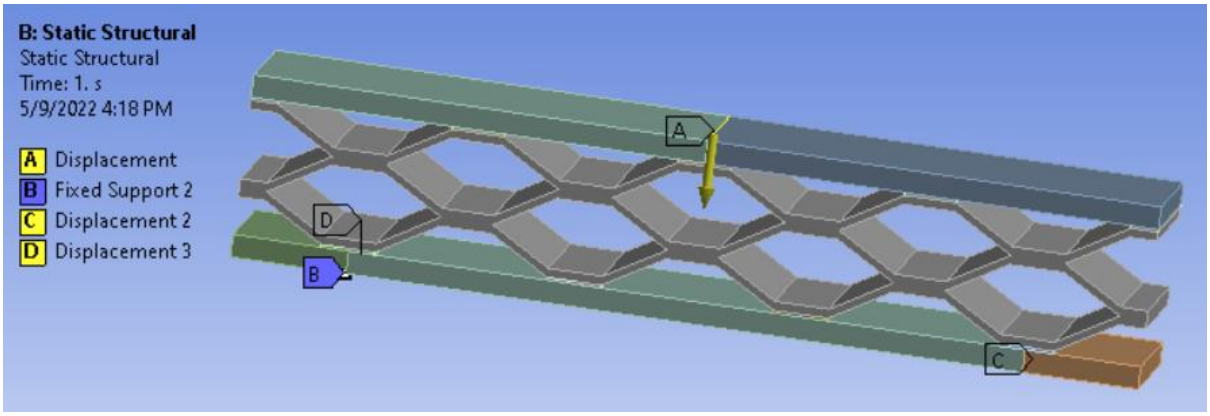

Fig. 5. The boundary conditions

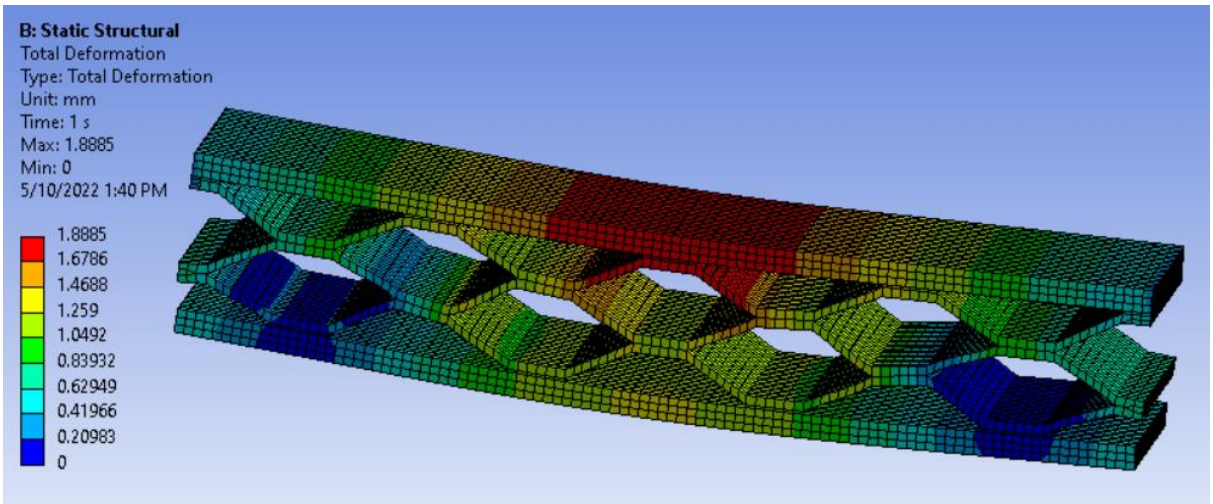

Fig. 6. Total displacement [mm]

3. The experimental part

3D printing is a process of forming a solid three-dimensional object of any shape. 3D printing is also distinct from traditional processing techniques, which are mainly based on the removal of materials by methods such as cutting.

The Fig.6 depicts the Vertex 3D printer that was used to print the PLA core.

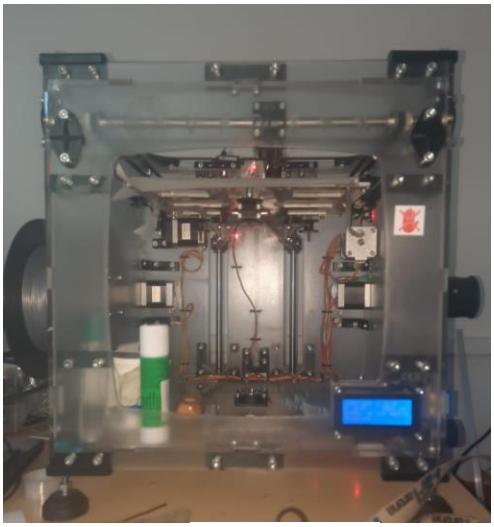

Fig. 8. Vertex 3D printer

CURA is an open-source application for 3D printers. It was created by David Braam, who was later hired by ULTIMAKER, a 3D printer company, to maintain the software. The CURA was originally released under version three of the Affero General Public License with open source, but on September 28, 2017 the license was changed to LGPLv3. This change has allowed for better integration with third-party CAD applications.

In Fig. 9 is the 3D printer that was used is marked with index one. The second index marks the two print heads of the printer. It can be seen that one head is inactive and the second one is assigned the material, PLA.

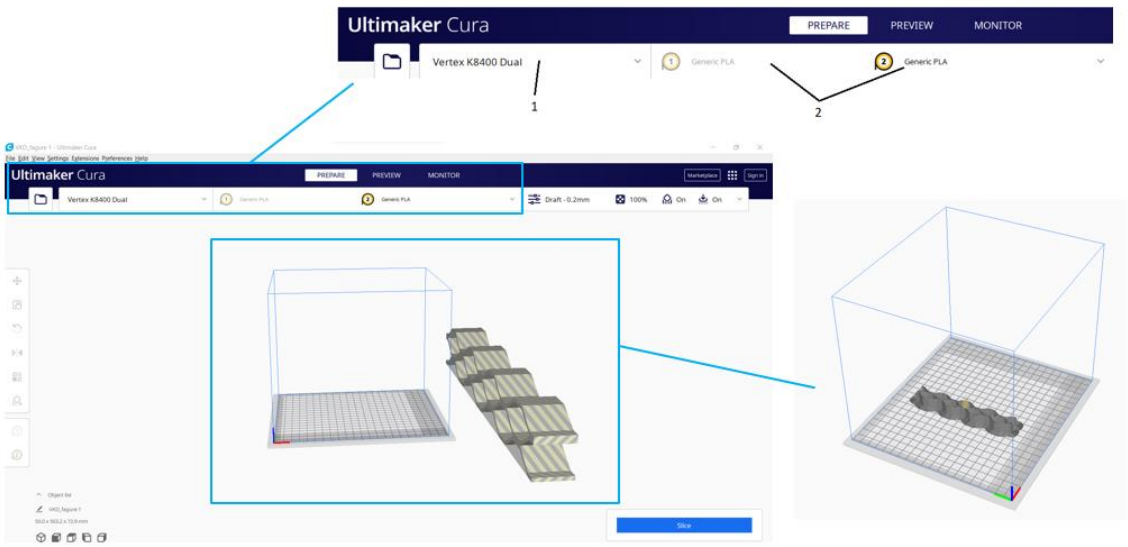

Fig. 9. Soft interface ULTIMAKER CURA

A virtual version of the 3D printer is generated on the right side of the new figure, so that the operator can estimate the maximum dimensions that he can use for a structure.

Once the structure has been dimensioned and positioned inside the virtual printer, a preview can be given to make sure everything is compliant.

The transfer of data from the program to the 3D printer was performed using an SD card. In order to access the geometry, the printer is equipped with a digital display like the one in the figure 10.

Fig. 10. 3D printer digital display

This screen shows us more information about printing. 190/200 ° meaning the temperature at which the printhead is located and 22/0 ° the ambient temperature. SD means that the structure being printed is on an SD card. It is not necessary for the geometry to be on the card, the printer can also print directly from the computer, however there is the possibility of a time delay, which could affect the structure leaving gaps.

That percentage of 22% refers to the percentage that the piece reached during printing, and below the word "Printing ..." suggests that printing is in progress.

This printer can use one or two printheads. If two printheads are used, the structure can have two colors. In our case it has been used a single printhead.

Fig. 11 shows the print head on the right side, the red LED indicating that the printing of the structure is in progress and on the left side you can see the roll of PLA filament that has been used.

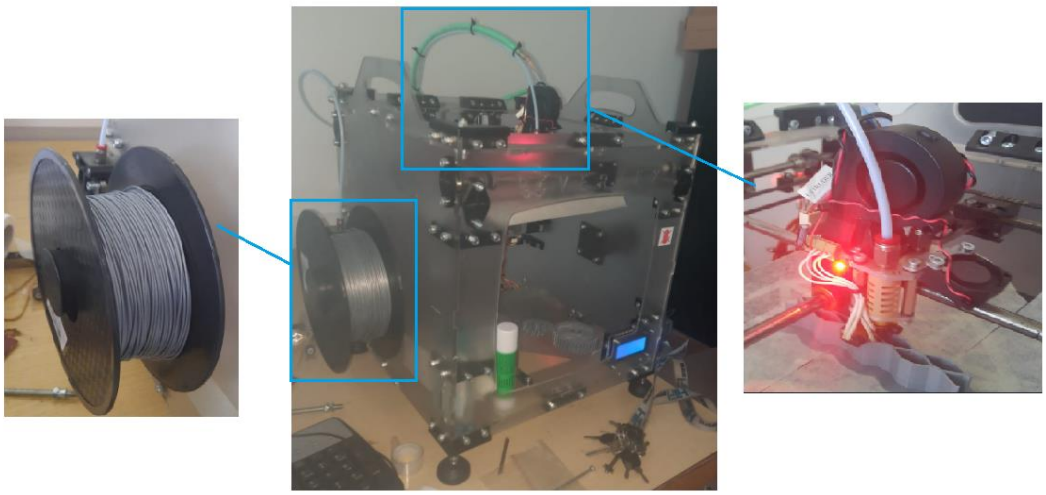

Fig. 11. 3D printer and they component

Polylactic acid (PLA) is a thermoplastic aliphatic polyester produced from renewable resources, such as corn starch (in the United States) or sugar cane in the rest of the world. It is biodegradable under certain conditions, such as the presence of oxygen, and is difficult to recycle.

The 3D printing filament is the thermoplastic raw material for 3D melt molding printers. There are many types of filaments with different properties that require different printing temperatures. The filament is commonly available in the two standard diameters of 1.75 mm and 2.85 mm.

PLA polymers range from amorphous glassy to semi-crystalline and highly crystalline polymer, with a glass transition of 60–65 ° C, a melting point of 130–180 ° C, and a Young modulus of 2.7–16 GPa. PLA is heat resistant, up to 110 ° C.

After the tiles were cut to the desired size, they were sanded at a 45° angle for better adhesion of the adhesive. They were degreased with industrial acetone and avoided touching them so as not to leave a layer of grease on them, as the adhesion of the adhesive would have been negatively affected

Fig. 12 Aluminum plates

Fig. 13 shows the adhesive that was used, which is a metal adhesive. It can be seen that it consists of two tubes, inside one of them being the base, and inside the second one being the hardener. I tried to put an equal amount of both in the plastic holder and mix them until a homogeneous substance was formed.

Fig. 13 Adhesive

The sandwich beam was subjected to a -point bending test as can be seen in Fig. 14. In order not to stress only the aluminum plates, the structure was supported in the area where the aluminum comes in contact with the PLA, and the displacement of was placed in the middle of the beam following the same principle. The required displacement was considered to be 1 mm/ min.

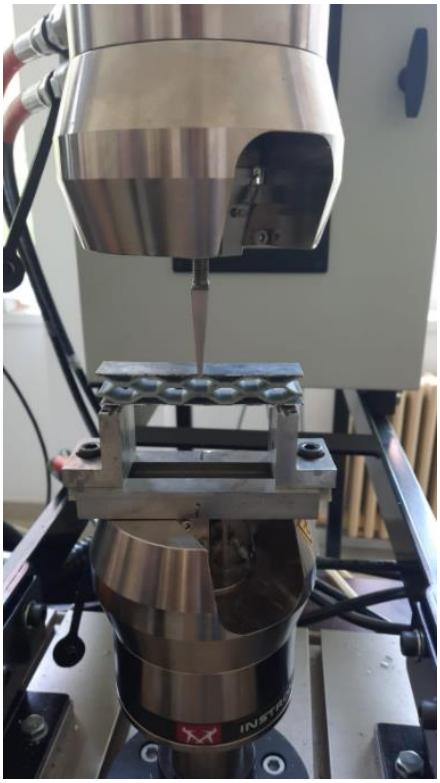

Fig. 14. Equipment used to perform three-points bending

3. Comparison of results

Table 2 shows the experimentally obtained data for the five samples. Sample one and sample two are the tests that failed due to incorrect application of the adhesive, and test four and five are the tests in which the core of the PLA failed. Sample three is a mixture of the previous ones, in this case it was observed that both the PLA core and the adhesive gave way.

Table 2. Experimental data

	Maximum Force [kN]	Maximum Displacement [mm]
1	0.48	1.6
2	0.34	1.21
3	0.54	2.22
4	0.56	2.26
5	0.5	2.13
Arithmetic average	0.484	1.88

From Table 3 it can be seen that the maximum displacement is the same because for the finite element analysis no force was used but an imposed displacement. To observe the difference between the results obtained experimentally and those obtained with F.E.M. we must look at the reaction of the forces. The difference of 0.126kN is an acceptable error.

Table 3. Comparison between experimental and numerical results

Results	Maximum Force [kN]	Maximum Displacement [mm]
Experimental	0.484	1.88
F.E.M	0.610	1.88

4. Conclusions

Following this test, it can be seen that samples one and two failed due to the way the adhesive was applied, while samples four and five failed due to rupture of the core of the PLA. Instead, sample three is a mix between the two failure modes. Due to the small size of the beam, buckling was avoided.

In order to allow the sample to move only vertically, "Fixed Support" was applied at one point, which is not possible in reality. Although there is only one element on the thickness of the core, this does not affect because we used "Qadratic" elements.

The loading was done gradually with a mm / minute to avoid obtaining unrealistic results. We made sure that the movement and the constraints were on one of the edges of the core, not in the empty spaces.

A very small difference can be seen by comparing the results. Experimentally the obtained force was 0.484 kN and through FEM a value of 0.610 kN was obtained.

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[2] https://en.wikipedia.org/wiki/Aluminium
[3] https://www.3m.com.ro/3M/ro_RO/bonding-and-assembly-ro/training-education/science-of-adhesion/surface-science-basics/
[4] https://www.filamente3d.ro/blog/comparatii-teste-si-opinii-produse/tot-ce-trebuie-sa-stiti-despre-pla-acidul-polilactic
[5] https://www.fih.upt.ro/personal/diana.bistrian/MEF/MEF.pdf
[6] Yazdani Sarvestani; Akbarzadeh A.H. ; Niknam H. și Hermenean K. (2018). "*Panouri sandwich polimerice arhitecturate tipărite 3D: absorbție de energie și performanță structurală*". *Structuri compozite*.

Calculus and modelling of a load-bearing structure design for the enlargement of the working space in a production line

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The chosen subject of this paper is focused on finding a solution for optimizing the working space for the IRB 4600-40/2.55 robot, manufactured by ABB, using a gantry structure being mainly formed of two translating axis (X and Y axis), with a suspended mounted system, with one of the purposes being to be used in the extraction of raw products from plastic injection machines (Fig. 1).

1. Introduction

The gantry structure represents a translating like axis mechatronic system associated with industrial robots in different cell types, with the role of increasing available working space on a rigid path and adapting the robot to the requests of the technological process it's used in.

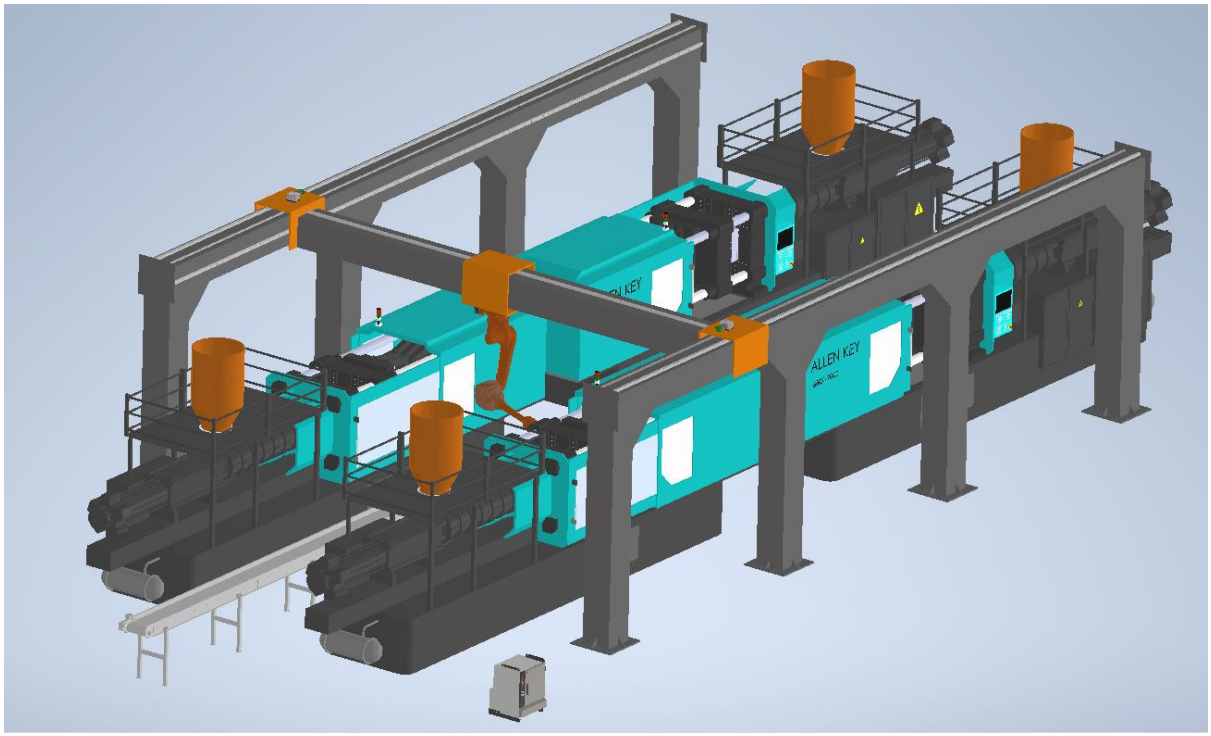

Fig. 1. 3D modelling of the cell

2. Actual state

Plastic injection machines are heavyweight industrial equipment with high demanding allocated space, like so having the need of a considerable amount of space. For extracting raw products resulted in the process of injection it is necessary to associate an industrial robot programmed to do this exact process. The association of this kind of robot (and more often of a solution to increase the working space for this robot) can lead to a significant increase of the ground space required, space that is already a problem with this type of machines, because of the space that they require (example Fig. 2).

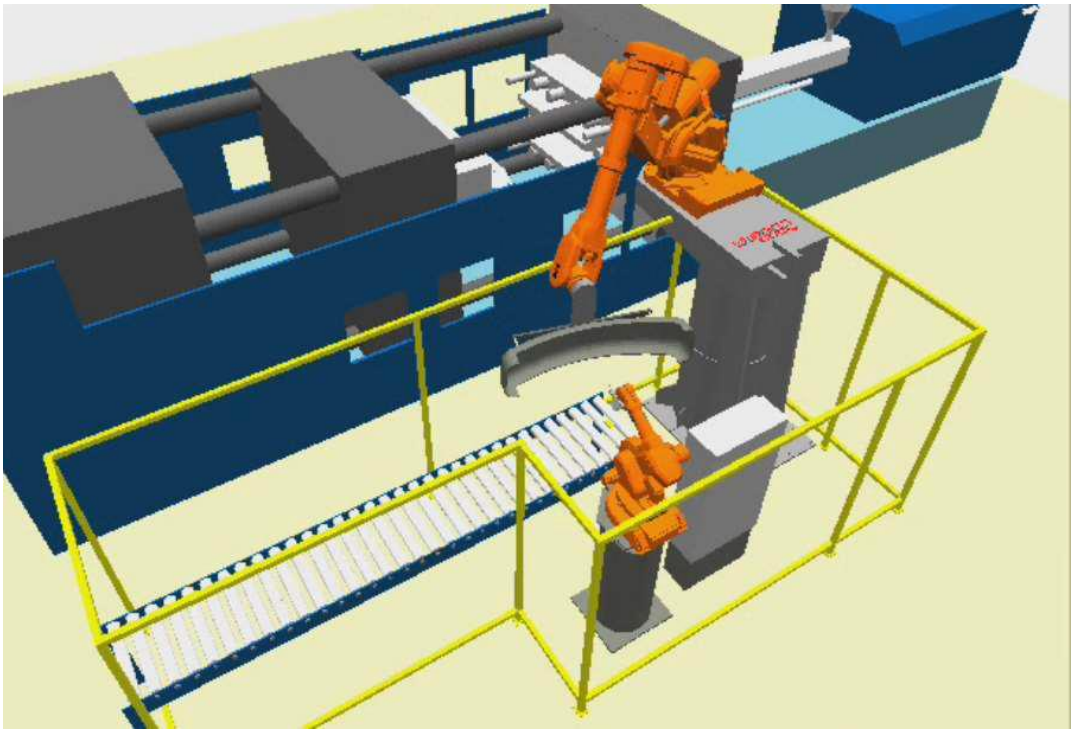

Fig. 2 Virtual simulation of a plastic injection process

In the production factories most of the time you can find one or more of this type of machines, every each one of them requiring a solution to extract the final product, fact that by cumulating leads to a significant issue referring to the space management available in the enclosure.

Mechanical structure overview

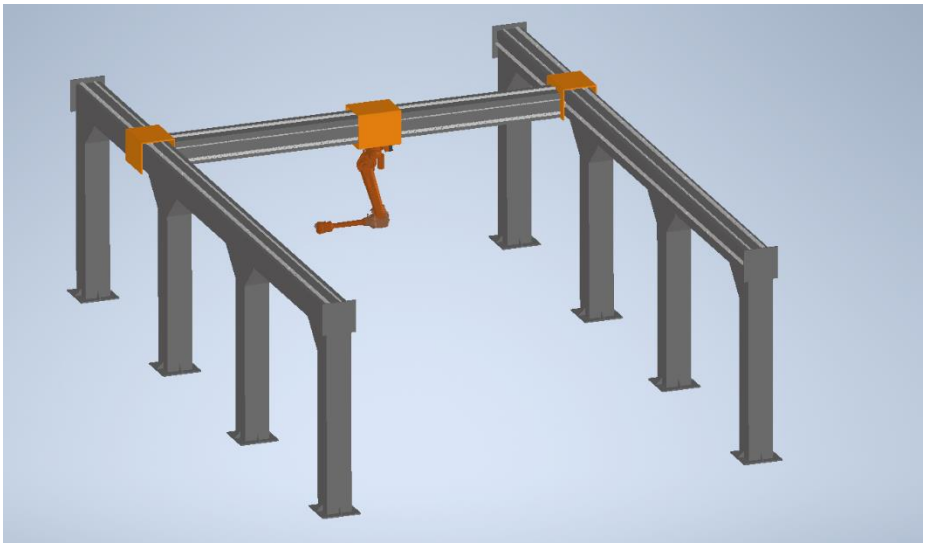

Fig.3 Isolation of the analysed structure

The constructive solution that we propose comes in the help of this sort of problems. The design and production of a structure that serves for more injection machines, working for each one of them, sequentially. This option comes with the following advantages:

- The reduction of footprint, because by eliminating the four independent structures for each machine with a single, bigger structure, it can overall lead to a better organization of the available space;
- The structure's reduction of technological complexity, the simplification of the programming algorithms and the decrease in electrical energy consumption;
- Also, we can observe a significant decrease in the matter of cost for building the entire line of production (the reduced number of robots required is ultimately leading to a lower price, some of the robots having prices between 25.000 $ and 400.000 $, and also by cutting off on the number of robots all the necessary equipment that are mandatory for an optimal execution are reduced);

  Although, like any solution, we can't present only it's strong points, it must have some disadvantages too, like for example it is observed that an increase in the necessary time to effectuate the same number of process cycles by a single robot, in comparison with the time required by four robots to complete them.

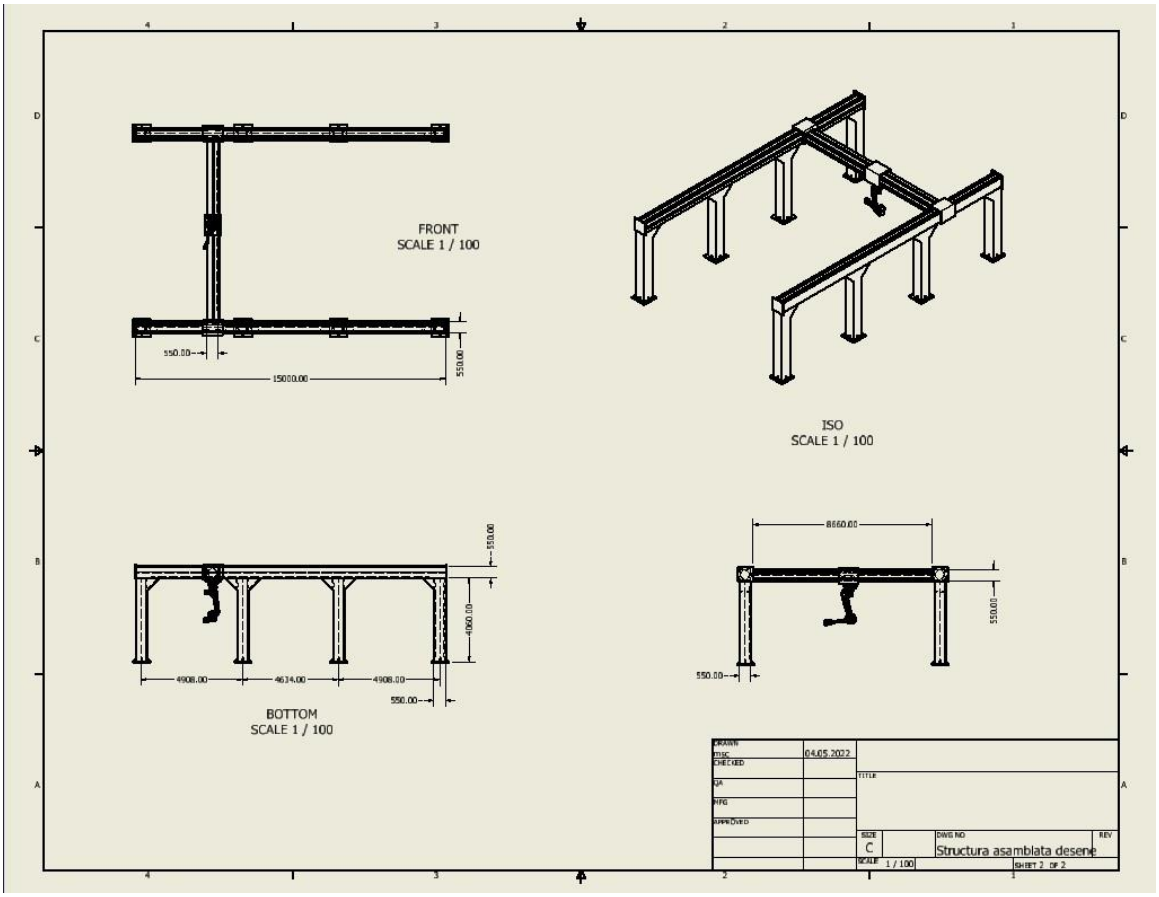

Fig. 4 Multi-view technical representation of the structure

Main specifications for the selected robot

In order to be able to design the gantry structure it has been extracted a series of technical information from the datasheet, such as the shape and the dimensions of the robot's working space, it's weight and maximum load capacity. The value and direction of the forces and moments that are developed during operation can be also extracted. This robot has been chosen because of it's capability of being suspended mounted, but also for its characteristics and applications which suits for plastic injection processes.

1.1.2 Different robot versions

General

The IRB 4600 is available in four versions and all versions can be floor mounted, inverted or tilted (up to 15 degrees around the Y-axis or X-axis).

Robot type	Handling capacity (kg)	Reach (m)
IRB 4600	60 kg	2.05 m
IRB 4600	45 kg	2.05 m
IRB 4600	40 kg	2.55 m
IRB 4600	20 kg	2.50 m

Manipulator weight

Robot type	Weight
IRB 4600-60/2.05	425 kg
IRB 4600-45/2.05	425 kg
IRB 4600-40/2.55	435 kg
IBB 4600-20/2.50	412 kg

Fig. 5. Versions, maximum payload, reach and weight for the ABB IRB4600-40/2.55

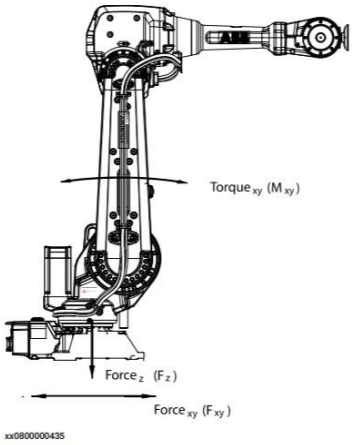

Fig. 6. Forces and moment displacements for the ABB IRB4600-40/2.55 while being reverse mounted (first view)

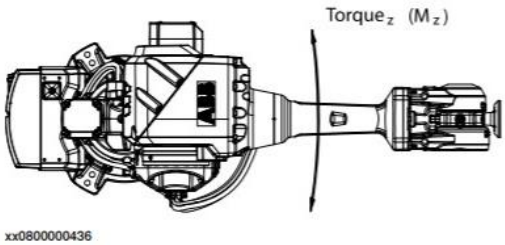

Fig. 7. Forces and moment displacements for the ABB IRB4600-40/2.55 while being reverse mounted (second view)

Maximum load in relation to the base coordinate system

Floor Mounted

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±3940 N	±7790 N
Force z	4350 ±2460 N	4350 ±6360 N
Torque xy	±6850 Nm	±14090 Nm
Torque z	±1610 Nm	±2960 Nm

Suspended

Force	Endurance load (in operation)	Max. load (emergency stop)
Force xy	±3940N	±7790 N
Force z	-4350 ±2460N	-4350 ±6360 N
Torque xy	±6850 Nm	±14090 Nm
Torque z	±1610 Nm	±2960 Nm

Fig. 8. Values of forces and moments developed by ABB IRB4600-40/2.55

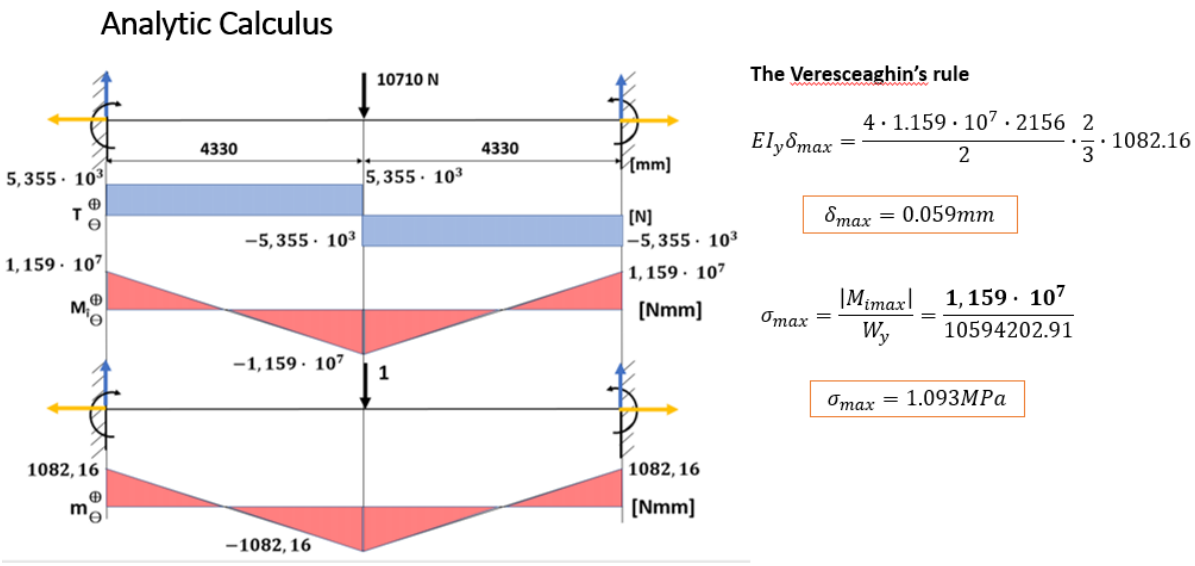

Fig. 9. Analytical calculus of the main beam and representation of diagrams [1], [3]

Simulation and analysis of the main beam in Ansys [2]:

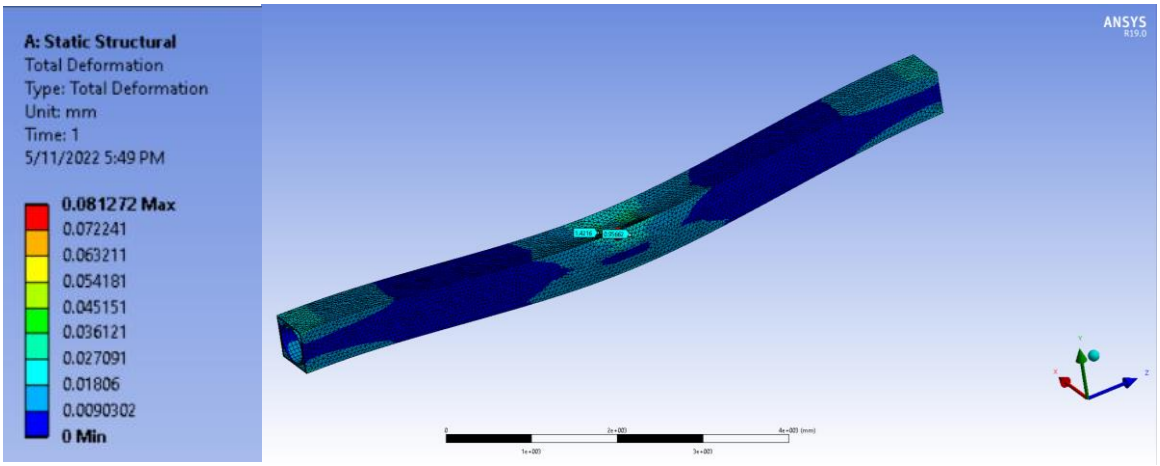

Fig. 10. Total deformation for the main beam

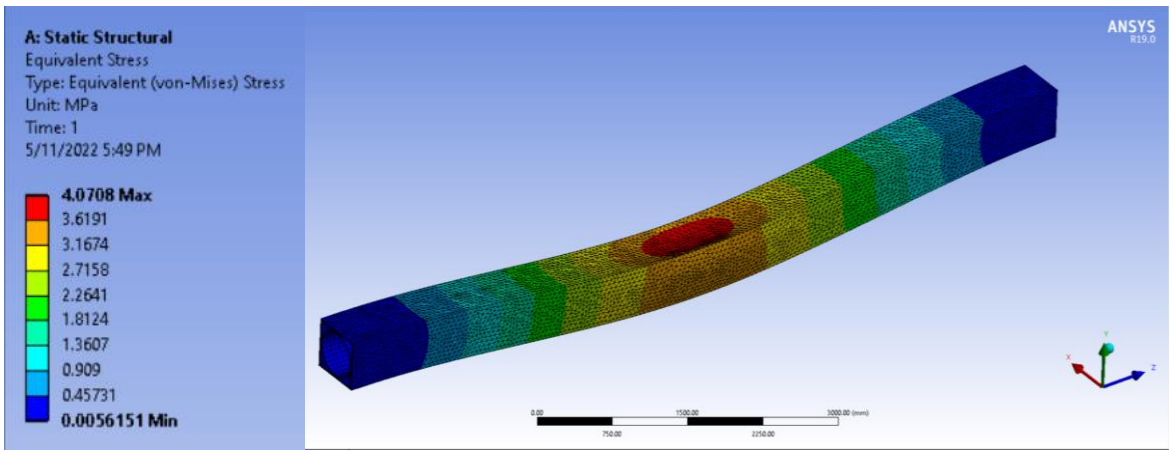

Fig. 11. Equivalent stress for the main beam

Simulation and analysis of the structure in Ansys:

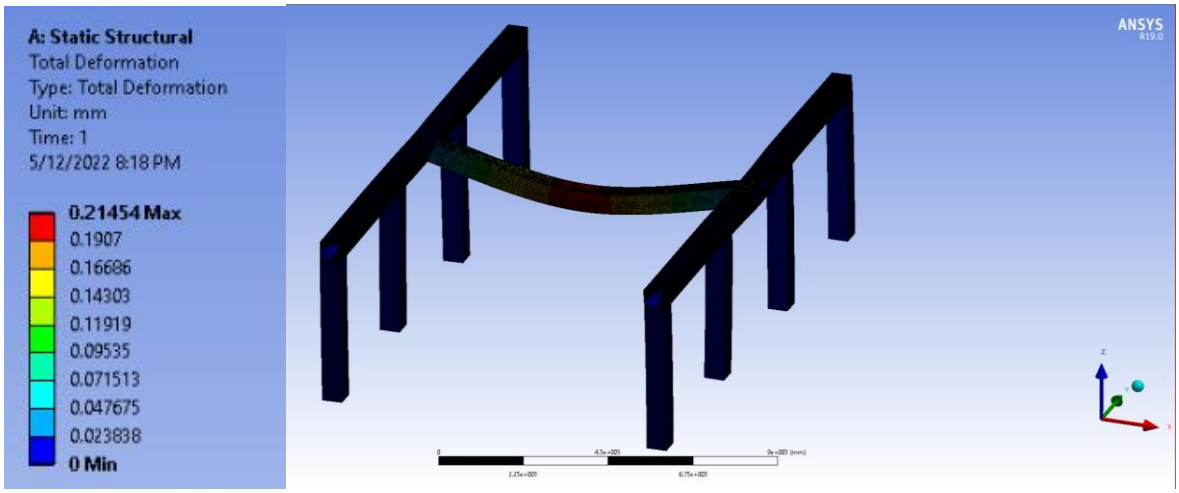

Fig. 12. Total deformation of the structure

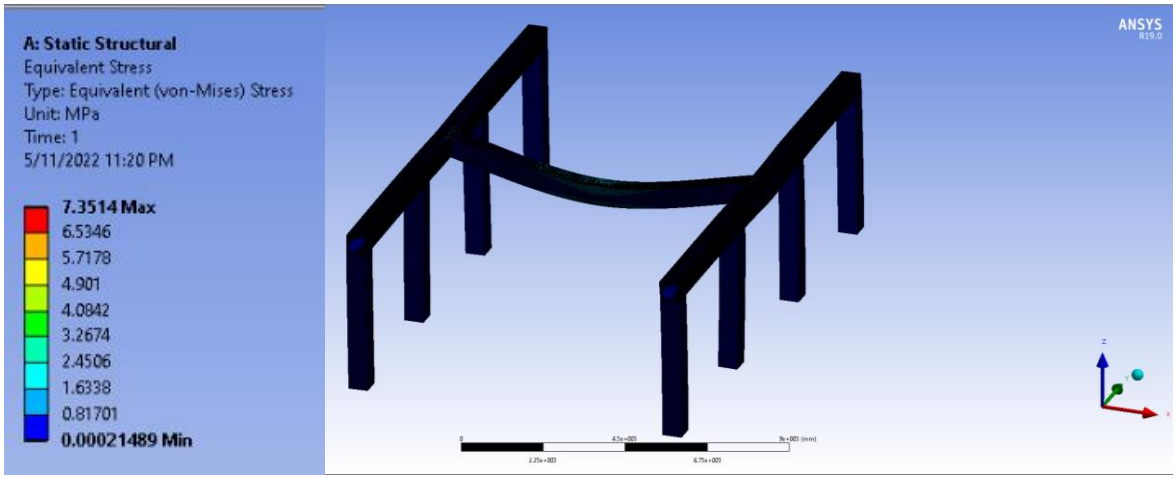

Fig. 13. Equivalent stress of the structure

The Veresceaghin's rule

$$EI_y\delta_{max} = \frac{4 \cdot 1.159 \cdot 10^7 \cdot 2156}{2} \cdot \frac{2}{3} \cdot 1082.16$$

$$\delta_{max} = 0.059mm$$

$$\sigma_{max} = \frac{|M_{imax}|}{W_y} = \frac{\mathbf{1,159 \cdot 10^7}}{10594202.91}$$

$$\sigma_{max} = 1.093MPa$$

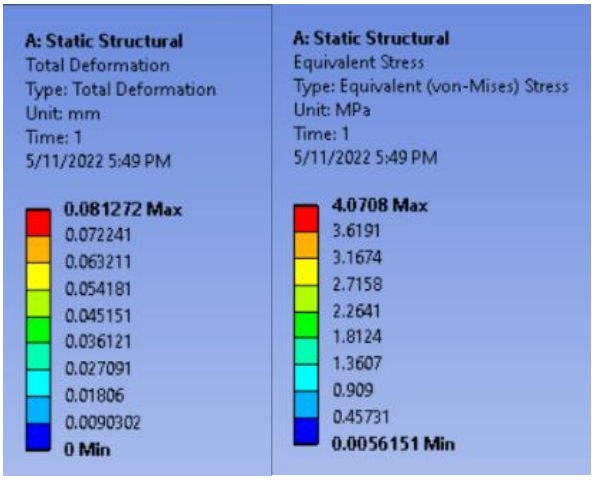

Fig. 14 Comparison between analytical result and simulation result

Conclusions

The study has reached the goals to design and simulate in as close to reality as possible of a gantry structure dedicated to a robotic cell. Comparing the final results obtained analytical (deformation 0.059 mm equivalent stress 1.093 MPa) with the results of the final element analysis (0.21454 mm total deformation and 4.0708 MPa equivalent stress), it can be observed that the values were similar, taking into consideration the total deformation and the equivalent stress of the structure. For furthermore development it could be taken into consideration the following directions of the study: thermic expansion behaviour, vibration influence over the structure, dynamic analysis and strain sensors research over real life miniature replica at a given scale.

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THE STRUCTURE AND OPERATION OF MILITARY DRONES

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ABSTRACT: In this material it will be presented to you "The structure and operation of military drones", the type and role of drones in the military field. Drone that retains in most respects all the qualities of a high-performance aircraft and performs interventions, but the greatest quality of this modern flying device is that it can reach its military targets without exposing the owner to danger.

KEYWORDS: drones, Military, UAV, rotor.

1. Introduction

The drone is a UAV (Unmanned Aerial Vehicle) device capable of flying without being piloted by a person, which was originally used only for military purposes to recognize targets and bomb strategic targets.

These types of drones have exclusive applications on the battlefield, to provide air support or to perform high-risk missions where there is no need to endanger human lives. They can be used to explore the terrain or to perform critical missions. Even when they are state-of-the-art drones, because of the risk of these drones being shot down or destroyed by the enemy, they are usually made of quality but they are still cheaper compared to an airplane. These drones are piloted remotely because military personnel are required to observe the drone's scenario in order to make decisions and order the drone to execute them. There are times when more than two operators are required to control the drone at the same time.

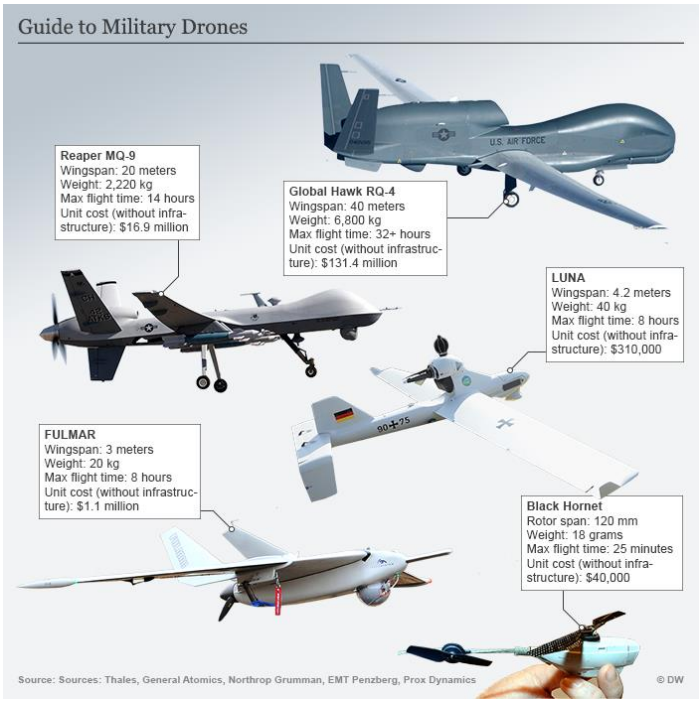

Fig. 1. Types of Drones

2. Current status

Types of drones

Military drones have come to revolutionize the war. Since their inception more than fifty years ago, drones have evolved steadily to the present day, becoming one of the leading artificial intelligence (AI) weapons integrated into military forces around the world.

- Micro drones

Micro drones could be used for field or military surveillance; or to bet on targets before personnel or other aircraft arrive on the battlefield. The most well-known example of this type of drone in action today is the Black Hornet, manufactured for the British military. When they are not in use, Black Hornets can be stored in a special belt. They can fly for up to 25 minutes on a single battery charge, and have a range of up to a mile. In addition, some Black Hornets have been outfitted with infrared cameras.

- Single-Rotor Drones

These are by far some of the most basic types of drones. As the name would imply, it employs only a single rotor (besides the tail unit in some cases) and can often generate thrust more efficiently than their multi-rotor counterparts. This can make them ideal for longer flight times. That said, there are drawbacks to that design. Larger rotor blades mean a higher chance of one accidentally injuring you. In addition, the drones are often not as stable, and while they can still hover over areas, they can also be more difficult to fly than drones that have multiple rotors to keep them balanced and airborne.

- Multi-Rotor Drones

Where a single-rotor drone looks like a helicopter and is able to maintain flight with a single rotor, these units have several rotors positioned at strategic points on the craft. These extra rotors can make it easier for the craft to maintain its balance and keep hovering. However, when it comes to different types of commercial drones, as a general rule of thumb, the more rotors you add, the less time the craft is able to remain airborne. As such, while these units offer good stability, they often top out at half an hour of flight time. In addition, most types of multi-rotor drones are not able to carry a heavy payload, as this would disrupt the balance maintained by its offsetting rotors.

- Fixed-Wing Drones

The lack of rotors and fixed-wing style of these drones make them more similar to controllable airplanes rather than the helicopter style of other drones. Rather than rotors, their wings provide vertical lift, which means they only need enough energy to keep moving forward, making them ideal long-range drones. Some fixed-wing drones can be gas powered. Where multi-rotor units cannot remain airborne long, a fixed-wing drone can remain in the air for as long as 16 hours of continuous flight. However, they are not able to hover the way drones with helicopter-style rotors can. The lack of a rotor also makes them harder to land. They must be very carefully brought in for an extremely soft “belly landing,” and in less-than-expert hands, this can go very wrong very quickly.

- Fixed-Wing Hybrid Drones

These types of drones attempt to take the best from fixed-wing and rotor-based designs, making for drones that feature both. A fixed-wing hybrid drone will tend to have a couple rotors attached to the ends of fixed wings. Many of these drones are actually based on designs for aircraft that have been around since the 1950s and 1960s. However, the technology to bring them to life was considered too difficult,

and they were largely shelved before the rise of drones. These units are still rather experimental, and so are far less commercially available than their single-rotor, multi-rotor, and fixed-wing counterparts.

Fig. 2. VTOL UAV prototype by NASA

- Tactical Drones

The preferred tactical drone of the US military is the Raven, which measures 4.5 ft and weighs 4.2 lbs. These types of drones are often used for surveillance work. As with the Black Hornets, the Ravens are capable of being outfitted with special infrared cameras, helping them supply soldiers with an accurate picture of the area even in the nighttime. The units come with onboard GPS technology. While they are on the simple side and do not boast a lot of bells and whistles, this also makes them quite accessible and easy for soldiers to use without the need for special training.

- Reconnaissance Drones

These drones measure around 16 ft long, are launched from the ground, and are called Medium Altitude Long Endurance (MALE) or High Altitude Long Endurance (HALE) drones. These drones are among the most commonly employed by militaries around the world. The Heron, designed by Israeli Aerospace Industries, has manufactured drones of this nature for military recon use for the US, Canada, Turkey, India, Morocco, and Australia. The drones in question can weigh over 2200 lbs and remain in the air for 52 hours straight at a cruising height of 35,000 ft. The German military makes use of another type of drone, the LUNA, which is less expensive than the Heron, but has shorter operational periods.

- Large Combat Drones

Variants such as the Predator and Reaper, used by the US, are around 36 ft long and able to fire on targets with air-to-surface missiles and laser-guided bombs. These units can operate for 14 hours over

a range of a thousand miles. These drones have been used for operations such as military strikes in Pakistan and other countries with which the US is not officially at war. The US may be the most famous (or infamous) user of drones, but they are hardly alone. Fellow NATO nations such as the UK, Spain, and France use them as well, while China has manufactured its own version, the CH-4, which has been bought by Egypt and Iraq.

- Non-Combat Large Drones

For example, the Global Hawk, manufactured by Northrop Grumman, is primarily used over combat zones, but not meant for combat. Rather, it is used for surveillance, such as scanning cell phone calls. Just because these drones do not engage in combat does not mean that they are not expensive. The Global Hawk, for example, can cost as much as $131 million, and that does not include ground infrastructure**.**

Fig. 3. Global Hawk Drone

- Target and Decoy Drones

One of the most important things to keep in mind about military drones is that they can serve several functions depending on the situation. For example, while some drones can be used for surveillance and others are meant for strike capabilities, these operate as decoys. What those decoy missions look like, however, is bound to change depending on the individual nature of the mission. As such, these types of military drones must be ready to act as decoys in any number of ways. For example,

some target and decoy drones can carry out their mission by simulating an incoming missile. This can draw fire from ground anti-aircraft units, thereby distracting them from any actual combat drones or incoming missiles.

Fig. 4. MQM 107E Drone

3. The benefits of using drones in the military (Conclusion)

The use of drones in the military field is already common. However, they are playing an increasingly important role in the civilian field - surveillance of borders, road traffic, disaster and calamity areas, conditions for public meetings or high-level meetings. Drones also have a special utility in agriculture - the condition of crops, pests but also for cadastre, for monitoring the environment, the level of pollution in various locations, for establishing the risk of floods on watercourses, for monitoring transport or in case of anti-terrorist operations. There will be many other uses in tourism and family events.

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SELF-REPAIRING MATERIALS

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Summary: People have always thought that self-healing materials are science fiction, but they will become our everyday reality. We will soon see an industrial revolution in which tires, concrete or even robots will self-repair following plastic deformation. Self-healing materials are our future. From saving money and lives lost in infrastructure collapses to improving human health and longevity, self-healing materials are being used in many areas today. Research is still in its infancy, but their potential is infinite. This is true for concrete, implants, paints, or even artificial skin.

KEYWORDS: Polymers, Shape memory, Encapsulation, Repairing agent, Fatigue failure.

1. Introduction

In everyday life, the materials we use are not indestructible and are therefore subject to damage of a micro or macro structural nature. The most common damages that can occur are: ageing (with the passage of time, materials lose their original properties, and can be completely destroyed in terms of several years), wear (after continuous use of materials, they can be destroyed by the frictional forces they are subjected to), defects (no material is perfect, they have many micro defects that can lead to their sudden breakage - fatigue failure - due to the stresses and strains applied). Against the background of these problems (the third of which is the most dangerous and the hardest to find), self-repairing materials appear.

These materials, as their name suggests, are artificial materials that can repair damage that inevitably occurs during work (cracks or fissures). Although most self-repairing materials are polymers and elastomers, metals, ceramics, and cemented materials can also be used.

2. History

We can take the example of the Romans, whose buildings have survived for almost 1900 years. Geologist Mari Jackson, along with her colleagues in 2014, have made the type of mortar used for Roman structures such as the Pantheon and Colosseum. It is made by mixing volcanic ash called Pozzolane Rosse, from the Alban Hills volcano in Italy, with quicklime and water which they used to bind pieces of tufa, a rock aggregate. Lime interacted with the chemicals in the whole mixture, producing crystals that replaced the mixture. The crystals are produced continuously, thus managing to hold the mortar and the coarse aggregate together, producing a self-repairing type of material.

3. Current status

Due attention started to be given to them in 2007 at the conference on self-repairing materials. The conference, led by Professor van der Zwaag of Delft University of Technology, the Netherlands and Professor White of the University of Illinois, USA, discussed the application of concepts from the most common self-healing materials to all materials. Reaching its seventh edition in 2019, the Conference for Self-Repairing Materials, held in Yokohama, Japan, has made this topic of interest again.

4. Biomimetics in the study of self-repairing materials

Biomimetics is the act of adopting some type of pattern, system or element of nature in order to create an artificial material. Clearly, the plants and animals that surround us can encapsulate and heal wounds. For all of them there are two stages: the first stage would be self-sealing and the second stage would be self-healing. In plants, rapid self-sealing prevents the plant from becoming infected by germs, which gives it time for subsequent self-healing of the wound, which, in addition to closing the wound, also restores its mechanical properties.

In the academic literature there is documentation that these biomimetic design approaches are being used in the development of self-healing systems for polymer composites. The DIW structure can be used to essentially mimic the structure of the skin. This work has shown partial recovery of strength after fracture and could be repeated several times due to the ability to restore the grooves after use. It cannot be repeated because the polymer in the crack plane from previous healing would accumulate over a longer time.

5. Polymers in the study of self-repairing materials

Polymer is a substance made up of very large molecules formed by joining together several monomer molecules (simple unsaturated molecules). In recent times, polymers have become a basic material for products such as plastics, rubbers, films, fibers, or paints that people use to make their lives easier. The very high demand has led to an extension of their reliability and lifetime in view of a new design class of polymeric materials capable of restoring their functionality after damage or fatigue. They are divided into two different groups depending on the approach of the self-healing mechanism: intrinsic or extrinsic. Self-healing polymers follow a three-step process very similar to that of a biological response.

6. Intelligent material

Intelligent materials are a special category of materials that need to fulfil certain functions: a detection function whereby cracks are located, a processing function whereby the material decides what action needs to be taken and an actuation function whereby repair takes place. In such materials these functions can be incorporated by special devices to repair cracks, tubular vessel-like networks or special resins that cure without the presence of water. Self-repair can be of two types: passive and active.

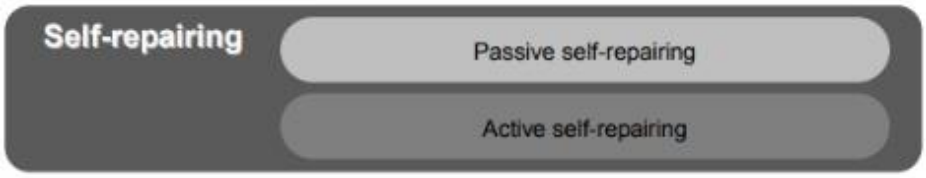

Fig. 1. Types of self-healing mechanisms [1]

7. Passive self-repairing

Passive self-repair is the process by which damage is repaired by releasing a repair agent from capsules inserted into the material composition. This basic concept was proposed by the Agency for Science and Technology in 1989.

A first study was carried out by Dry in 1994. A crack in a brittle cement concrete caused by overheating of the material was repaired by releasing capsules containing brittle glass fibers. The bonding agent (the glass fiber capsules) can be and thus fill the crack.

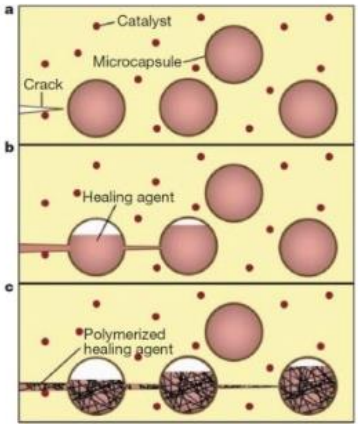

Fig. 2. Example of passive self-repair [2]

In 1998, the composition of PSS-ECC self-healing cement was investigated. In this case, the bonding agent is brittle fiber tubes containing ethyl acrylate. In this study, the importance of the value range in which the repair agent works was emphasized. Thus, the dimensions must be within a few tens of microns, otherwise the adhesive agent will not be sufficient. For larger cracks, thick hollow glass tubes are needed, but they reduce the mechanical properties of the material. The drive mechanisms must also be considered. Thus, the maximum width should be less than the inner diameter of the glass fiber.

Another study conducted in 2004 attempted to recover not mechanical properties but water permeability. Fragile glass tubes embedded in a HPFRCC matrix were used as a repair agent. The graph below shows the relationship between maximum width and water permeability. The results show that at widths less than 0.2 mm, due to the viscosity of the repair agent, self-healing was more ineffective than for cracks larger than 0.2 mm.

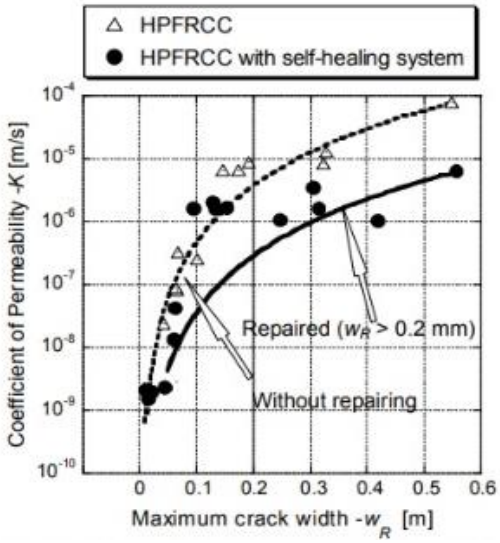

Fig. 3. Dependence of permeability on maximum crack width [3]

8. Active self-repairing

Because of the brittle capsules used in passive self-repair, the use of such materials on site is much more difficult. So new materials have been tried.

In 2003, Sakai proposed the use of a shape memory alloy (SMA) to close cracks.

The "shape memory" phenomenon is present in certain alloys with reversible martensite transformation in which the structural constituent has a thermoelastic character. A product made of an alloy can be deformed from an initial shape with a thermally stable configuration to another shape with a thermally inconsistent configuration. This product can be said to have a shape memory because it can return from a thermally unstable configuration to its original, thermally stable configuration when heated, i.e., it can be said to remember its original shape. Metallic alloys with the property of returning to their original shape is the result of the fact that they exhibit a reversible transformation from a current state to a martensitic state when the temperature changes. As this is a relatively new field of advanced technology, the data on the production of these materials and their applications are far from being sufficiently well known, although a great deal of research is being carried out internationally in this area, with results being published after the new products have come onto the market.

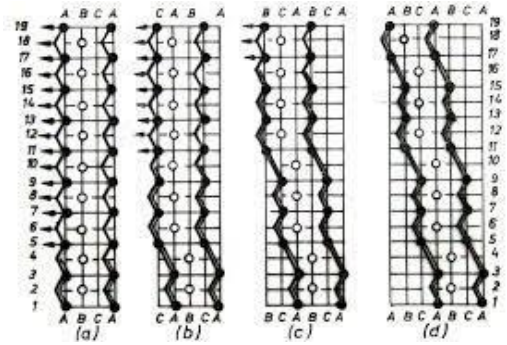

Fig. 4. Successive stages in the transformation of a shape memory material [4]

Nishiwaki in 2006 developed a new approach that can be called "active self-healing system". Following cracks in the concrete that trigger electrical stimuli from a sensor, self-repair starts automatically. The system consists of a conductive composite for self-diagnosis of cracks, made of a thermoplastic film and a resin as a repair agent. The self-diagnostic composite is used to monitor cracks like a sensor. The sensor can, in the absence of any deformation, monitor the deformation using the conductive path with dispersed particles. Around a larger crack detected by the sensor, the electrical resistance of the sensor increases because part of the electrically conductive path around the crack is cut off. With the sensor, selective heating can be achieved around the crack. Knots were installed on the surface of the self-diagnostic composite, and between them the composite was covered with a polyethylene film. Thus, this foil eliminated the bond between concrete and composite and the width of the crack was related to the deformation measured with a certain accuracy.

9. Reversible polymers

Polymers don't always need internal performative systems, such as embedded capsules or vascular tubes, to repair internal wounds. Some of them break apart to reveal what we might think of as highly "reactive" heads or fragments that naturally try to rejoin. Driven by either light or heat, these stray fragments naturally try to rejoin with other nearby molecules, reversing the damage and repairing the material. Some break off to expose their electrically charged ends, giving the broken fragments a built-in electrostatic attraction. Damage occurs when electrostatic forces pull the fragments together, allowing the material to repair itself. Sometimes all you need to repair damage is a little heat.

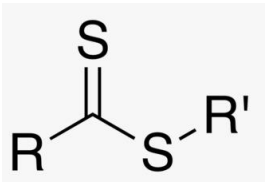

Fig. 5 Shows a reversible polymer fragment [5]

10. Photopolymerization

A team of researchers at the University of Southern California's Viterbi School of Engineering has developed a self-repairing material using the light-curing technique. By chemically modifying a resin, it became self-repairing, and by solidifying it using light, the desired shape is achieved.

By reacting a group called thiols with thiol-oxidizing agents, they obtain sulfides, a group that can repair itself. This is the basis of photopolymerization.

Wang explains: "When we gradually increase the amount of oxidant, the self-healing property becomes stronger, but the photopolymerization behavior is reduced. There is a competition between these two behaviors. And eventually we found the ratio that allows fast regeneration and relatively fast photopolymerization."

The researchers have shown that in just a few hours (depending on the volume of the object) it is fully regenerated. For example, a cube with a side of 17.5 mm^2 can completely self-heal in just two hours at a temperature of 60 degrees Celsius. By increasing the temperature, the material can repair itself faster.

11. Applications

Self-repairing materials have numerous applications in everyday life from industry to medicine. We can imagine how buildings, bridges or even asphalt can close cracks on their own, how cars damaged at low speeds can be repaired, and how even a common paint scratch on a car no longer requires a service visit. We can experiment with self-repairing car linings and even implants or artificial skin that mimic their natural counterparts. Accidents during work could also be avoided, leading to lower repair costs and safer working conditions for human operators.

12. Conclusions

Now that we've discovered self-healing materials, let's look at some of the advantages and disadvantages of these. The advantages of self-repairing materials are their longer lifetime, lower maintenance time, which allows for higher productivity, fewer accidents during operation and improved quality of life through their use in the medical field.

As regards passive self-repair, one problem is the impossibility of repairing larger cracks. Also, the incorporation of self-repairing components into the mats and ceramics is a laborious and still rudimentary process. Finally, after repair some materials may have their physical, chemical, and mechanical properties affected.

Thus, although much more research is needed in this area, due to the multitude of applications they can achieve, we can expect a real revolution in these materials.

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HUMANOID ROBOTS - DESIGN AND PERFORMANCE

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ABSTRACT: *In this material you will be introduced to "humanoid robots - design and performance" aesthetics and everyday performance. A humanoid robot is a robot that resembles the shape of the human body. The design can be for functional purposes, such as interaction with tools and human environments, for experimental purposes, such as the study of bipedal locomotion or for other purposes.*

KEYWORDS: humanoid robot, aesthetics.

1. Introduction

A robot is a system composed of several elements: mechanics, sensors and actuators and steering mechanisms. The mechanic determines the appearance of the robot and the possible movements during operation. Sensors and actuators are used to interact with the system environment. The objective mechanism ensures that the robot successfully achieves its objective, for example by evaluating the sensor information. Humanoid robots are now used as research tools in many fields of science. Researchers are studying the structure and behavior of the human body to build humanoid robots. On the other hand, try to simulate the human body to better understand it. Human cognition is a field of study focused on how people learn from sensory information to acquire perceptual and motor skills. This knowledge is used to develop computational models of human behavior that are refined over time.

Fig. 1. Sophia Robot

2. Current stage

Types of humanoid robots:

Sophia Robot: She is one of the most famous humanoid robots and has been granted the citizenship of Saudi Arabia, becoming the first citizen robot in the world. It was developed by Hanson Robotics, a Hong Kong company founded by Dr. David Hanson in 2013. It is a robot modeled after actress Audrey Hepburn. He is one of the most advanced humanoid robots in the world, with an integrated neutral formula and constantly learns from everything around him and around him. Unlike other robots, Sophia is endowed with artificial intelligence, capable of facial recognition and visual data processing. The Sophia robot is capable of certain conversations because it can answer certain questions.

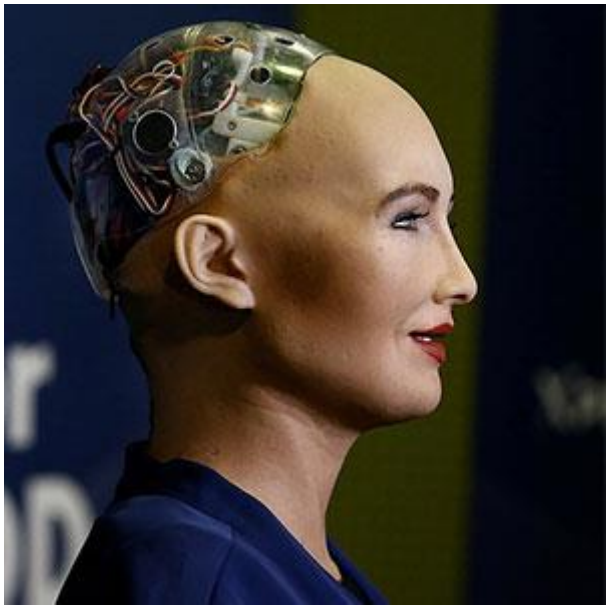

Fig. 2. Sophia Robot - details

Pepper Robot: He is one of the most advanced humanoid robots in the world, with an integrated neutral formula and constantly learns from everything around him and around him. Unlike other robots, Sophia is endowed with artificial intelligence, capable of facial recognition and visual data processing. The Sophia robot is capable of certain conversations because it can answer certain questions.

Fig. 3. Pepper Robot

Erica Robot: Erica, the humanoid robot, will become the world's first TV presenter as she is filmed by Japanese television. It is a powerful robot that can turn its head where it hears voices and can identify who asks a question. It has one of the most advanced speech synthesis systems ever developed. Created by Hiroshi Ishiguro of Osaka University, she looks like a 23-year-old girl.

Fig. 4. Erica Robot

Reem Robot: The robot was created by PAL Robotics to perform certain activities, to provide information, to have conversations and even to give presentations in several languages. Has the ability to speak 9 foreign languages, but also facial recognition. It's the humanoid robot that's being used as a cop in the Dubai Mall. Until now, it has also been used in museums, fairs, shops and even airports.

Fig. 5. Reem Robot

ICub robot: It is the humanoid robot created by the Italian Institute of Technology of Genoa that has the ability to move its arms, head and legs. He has tactile sensors and can hear and see, and artificial intelligence helps him interact with others.

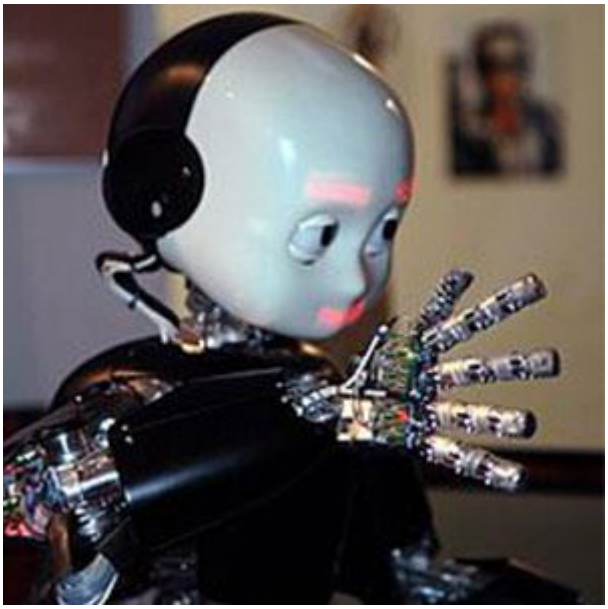

Fig. 6. ICub robot

Although the original goal of humanoid research was to better build orthoses and prostheses for human beings, knowledge was transferred between the two disciplines. Examples include motorized leg prostheses for neuromuscular deficiencies, ankle-foot orthosis, realistic biological leg prosthesis, and forearm prosthesis.

In addition to research, humanoid robots are being developed to perform human tasks, such as personal care, through which they should be able to help the sick and elderly, as well as dirty or dangerous jobs. Humanoids are also suitable for some procedure-based vocations, such as reception desk administrators and car production line workers. In essence, because they can use tools and use equipment and vehicles designed for human form, humanoids could theoretically perform any task that a human being could perform, as long as they have software. However, the complexity of this is immense.

With the increase in speed and the use of dynamic gait, external sensors are needed, mainly the video camera, which can transmit data about the environment and the ground.

Image processing and the complexity of control algorithms challenge very long computational times, which limit travel speeds.

Experts believe that the efficiency of visual sensors and image processing will increase dramatically in the near future, as it is the subject of assiduous research in many fields.

Handling and gripping

A humanoid robot must interact with its environment. An important role in this interaction belongs to the handling functions, which serve to catch, transport and handle objects.

Not all humanoid robots need sophisticated arms and hands, many can handle clamps with two jaws, which mean and open, or hands with 2-3 simpler fingers.

Utah / MIT hand

It is built of 3 fingers with 4 degrees of mobility and a thumb with another 4 degrees of mobility. The joints are operated with the help of high-speed pneumatic artificial muscles by means of strong polyethylene tendons.

For each joint, 2 muscles and 2 tendons are used, resulting in a total of 32 muscles and 32 tendons.

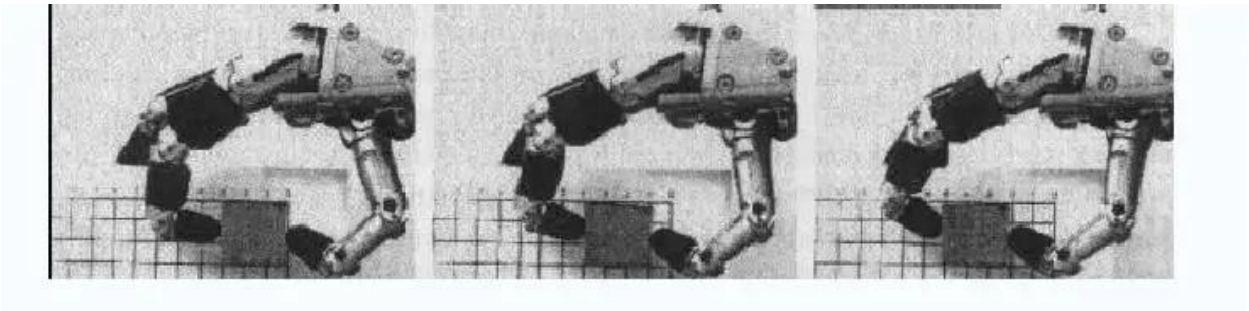

Fig. 7. Utah / MIT hand

3. Conclusions

According to specialists from the Universities of Bristol and Essex in the UK, humanoid robots will play an increasingly important role in human life, being designed to have as many specific human abilities as possible and to play the role of "friend of the future". they managed to create the first humanoid robot that can reproduce in real time various complex facial expressions. Applications of humanoid robots in large areas of human life regarding human assistance, psycho-motor recovery, rescue in disaster situations, exoskeleton, entertainment with advanced human-robot interaction, leads to the development of "sociable" robots that can communicate in a way that supports the natural ways of human communication.

The perspectives of the humanoid robot evolution are to play a role more and more important in human life and to become his “the future friend”. Thus, they will be capable to save the human’s life or to win a football game against him. Moreover, they will be capable to chat to humans, to maintain the household clean or to dance and entertain the humans. All these in order for the human-robot interaction to be friendly.

The robot evolution has just begone and in the near future we will see incredible achievements.

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COMPANIES STRATEGY FOR CUSTOMERS SATISFACTION

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SUMMARY: One of the biggest challenges facing organisations is customer satisfaction. To own success, companies must consistently focus their efforts and priorities on understanding and meeting the needs and expectations of all their customers. At the same time, they must identify the right methods and tools to measure customer satisfaction and ensure customer loyalty. The case study consists of evaluating the customer satisfaction strategies of three companies, Altex, CCC and H&M, using the triangulation method. Triangulation will be carried out using three tools: a checklist based on a structured interview with an employee of each company, an analysis of each company's website and a survey in which 100 customers expressed their opinion about these organisations. Finally, conclusions will be drawn according to the chosen hypotheses (companies are interested in customer satisfaction; companies have defined their key values; they define their stakeholders and target them with their approaches; they align their approaches with regional, European policies).

KEYWORDS: customer orientation, customer satisfaction, companies' strategy.

1. Introduction

In this scientific paper, a case study was carried out, looking at customer satisfaction strategy from the perspective of three well-known companies.

Companies, in general, aim to create a customer-oriented environment, constantly focusing their efforts towards knowing and meeting the expectations of all their customers, to provide trust to them and other stakeholders, to promote their services or products. Through all this, companies make themselves stand out in the market, targeting their field of activity.

2. Status

The success of a business is determined by the effectiveness of the strategy it follows. Customer orientation is a business strategy that involves prioritising customer needs and desires. Satisfaction develops the approach, a customer's condition is achieved by comparing the quality of a product/service with their expectations. Satisfaction is also the difference between appearance and essence which is measured by the quality level offered by the products and services tested.

To increase customer satisfaction and loyalty, and to remain competitive in the market, they adopt this approach. Companies are also constantly identifying and gathering customer data and information to meet their priority objectives.

A customer-focused organisation can predict future customer behaviours and, as a result, better meet their needs and desires. By knowing what creates value for the customer, collecting and analysing relevant customer data and information, constantly and dynamically adopting methodologies that meet customer requirements, businesses can develop long-lasting customer relationships that can benefit all stakeholders.

In general, the information received by the client comes from advertisements, advertising, own experience, the experience of acquaintances, information gathered from the company. Thus, the firm needs to review the methods it uses to promote its image in the market and gain customer recognition.

Based on the four hypotheses, we will analyse how the three companies, ALTEX, CCC and H&M, adopt the customer orientation strategy, by the triangulation of three tools: checklist, site analysis and questionnaire.

The premises consist of developing four statements about how organisations aim towards customer satisfaction. These are:

- The first hypothesis relates to companies which are interested in customer satisfaction.
- The second hypothesis refers to companies that have defined their key values.
- The third hypothesis focuses on the companies define their stakeholders and target them through their approaches.
- The fourth hypothesis is based on companies align their approaches to regional, European policies (e.g., environmental policy).

Altex is a company that sells home appliances, IT equipment and components [1]. Altex started its activity in 1992, in Piatra Neamț, in Neamț County. Dan Ostahie, one of the most famous entrepreneurs in Romania, borrowed $ 10,000 from the bank, with which he started importing second-hand TVs from Switzerland. The TVs brought from Switzerland were repaired and then sold through consignments that sold, among other things, clothes, and household products. Later, in 1993, Dan Ostahie opened the first home appliance store in the Altex network. Altex continued to grow its network of stores, opening more than 50 outlets in all major cities in the country. [2]

CCC is a footwear and accessories retail chain [3]. The company was founded by Dariusz Milek, a graduate of a mining school, who in 1991, after the fall of communism, sold goods in an open-air market in Lubin. In 1996, he opened a chain of cheap shoe stores called Golden Feet. In 1999, as the retail sector began to grow in Poland and malls began to emerge, Milek founded the CCC chain of stores, which is now present in almost every mall in the country. Until 2000, the Pole also had a shoe factory, and in 2004 he listed the company on the Warsaw Stock Exchange. In 2009, the company owned 585 stores in Poland and 29 in the Czech Republic, and Dariusz Milek was one of the richest people in Poland. The company has been present in Romania since the summer of 2012, when it opened the first shoe store in Feeria Galleries in the Băneasa shopping area. In 2014, the network reached a number of 19 stores, of which 5 in Bucharest and 3 in Iasi. [4]

H&M is a clothing company that originated in Sweden [5]. The company was founded by Erling Persson in 1947, when he opened his first store in Västerås, Sweden. The store, called Hennes (Swedish for "hers"), and sold exclusively women's clothing. Later, another store was opened in Norway in 1964. In 1968, Persson acquired the Stockholm-based hunting clothing retailer Mauritz Widforss, which led to the inclusion of a men's clothing collection in the product range and a name change to Hennes & Mauritz. The company was listed on the Stockholm Stock Exchange in 1974. Shortly afterwards, in 1976, the first store outside Scandinavia was opened in London. H&M continued to expand in Europe and began retailing online in 1998, with the hm.com domain registered in 1997, according to Whois data. [6]

They sell their products both in the national retail network and online.

The checklist was based on a structured interview with an employee of each company. In this interview, the employee was approached by a customer and put in a specific situation, thus analysing the satisfaction of the solution.

In Altex, the interview consisted of a request for information. The customer wanted to know the specifications of a particular product and the best option for purchase. The employee's response was disappointing as he did not know how to answer, not having technical knowledge. Thus, he showed a lack of experience and interest in dealing with the request.

The CCC store employee's interview consisted of a presentation of a real problem. The customer wanted to return a product purchased on the same day but did not have the receipt. Without this, according to the return policy of this company, the product cannot be returned. Despite this, the employee sought to resolve the problem by calling his superior who eventually carried out the return process. The staff showed interest in resolving the problem despite the difficulties encountered.

H&M supports and promotes sustainability, so the interview was based on questions about sustainability. The client wanted to know how sustainability is achieved, an approach that appears in different campaigns. The employee in question, lacking sufficient knowledge, was not able to give further information about this and suggested looking for details online. After further exchanges, the customer left

dissatisfied with the answers received. In contrast to the previous case, the employee showed indifference towards the company's customer.

At the end of this checklist, each firm profiled itself through the lens of its customers and thus it can be said that the only firm that met customer expectations was CCC.

The second tool to perform triangulation is represented by site analysis and is the place where useful information (such as: texts, images, sounds, programs) can be accessed, usually on the Internet. At the same time, it is the interface between the company's location itself and the virtual company, accessed from anywhere, at any time. Part of their analysis will be approached in terms of highlighting their particularities, presented in Table 1:

Table 1. Company particularities.

	ALTEX	CCC	H&M
Simple and attractive web design	✓	✓	✓
Possibility to log in on your own	✓	✓	✓
Promotional offers	✓	✓	✓
Promoting procurement security	✓	✓	✓
The existence on the site of a telephone number for complaints	✓	✓	-
Possibility to sort articles according to certain criteria	✓	✓	✓
Possibility to choose a price range for items	-	✓	-
Online technical support	✓	✓	✓
Possibility to choose the display language of the site	-	✓	✓
Possibility to choose the currencies in which the prices are displayed depending on the language and the chosen country	-	✓	✓
The site can be accessed from any device	✓	✓	✓

Within the three companies, websites are accessible, usable by anyone, regardless of the device they are accessed from. Its content is structured, organised, and understandable to everyone. As for the overall quality, privacy, return and complaint handling policies, these are presented and described differently for each company.

Taking them individually, on the ALTEX website, only several objectives and approaches are structured [7]. At the same time, the CCC company, encompasses a few different concepts and expands on several areas. [8]. The latter company, however, promotes a wider range of approaches, such as that with reference to animal welfare policy [9]. Among the policies and objectives of the companies found on the website, the most important ones will be presented in the table below, called Table 2.

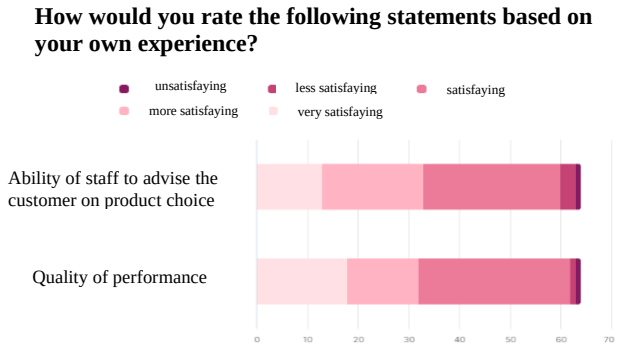
Table 2. Company policies and objectives [7]; [8];[9].

ALTEX	CCC	H&M
Vision	Vision	Employee Code of Ethics
Mission	Mission	Consumer protection
Culture	Values	Global Complaint Policy
Return policy	Ethics	Privacy Policy
Buy-back policy	Correction	Global non-discrimination and non-harassment policy
Complaints handling policy	Security	Sustainability
Privacy policy	Respect for the environment	Tax policy
Warranty certificate	Return policy	Investor relations
Environmental protection	Complaints handling policy	Animal welfare policy
	Privacy policy	Global Diversity, Inclusion and Equality Policy
	Warranty certificate	Return policy
		Complaints handling policy
		Privacy Policy

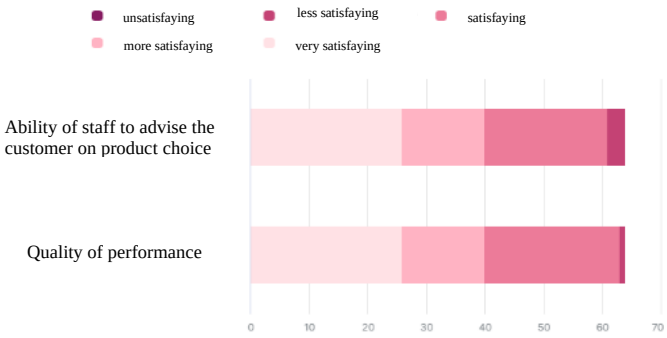
From the analysis of the sites, it is clear that their profile is different and that each has a distinct approach due to the field in which they operate. Thus, H&M's website describes its policies and objectives in a transparent and detailed way, while ALTEX and CCC share broadly similar ideas.

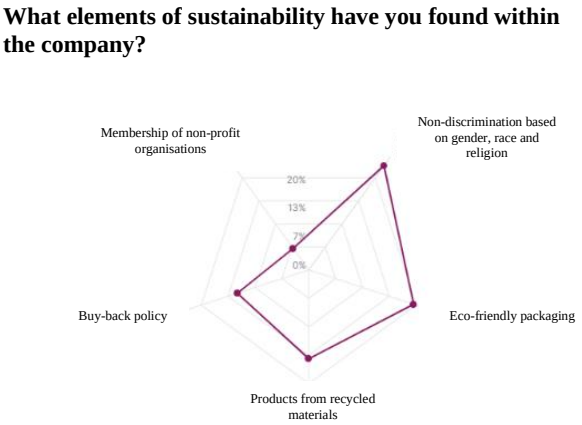
The third instrument of the triangulation, the questionnaire [10], was carried out on a sample of 100 people whose answers contributed to the complete definition of the scientific research work. The questionnaire was divided into two structures, the client's perspective on the strategy of his satisfaction and the company's orientation towards current values. Figure 1 will present the most relevant answers regarding the quality and capability of staff performance and the sustainability of companies, more precisely the representative elements of sustainability known to those surveyed.

ALTEX

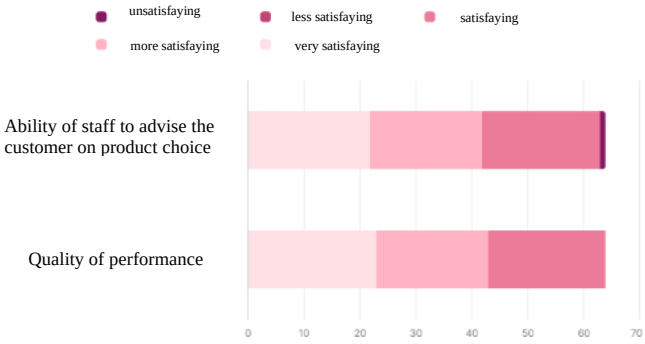


CCC





H&M



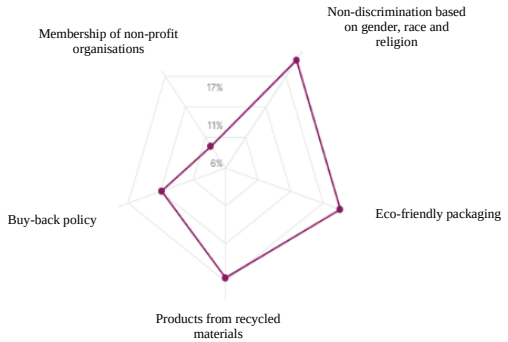


Figure 1. Questionnaire answers

The degree of satisfaction of ALTEX's customers made it possible to assess the subject of the research based on the answers given by the respondents. Thus, the hypothesis that companies are interested in customer satisfaction was verified. It appears that 75% of the respondents are satisfied with

the customer orientation of the staff. Based on another assumption, 78% consider that the way and time complaints were handled was satisfactory. 86% of customers rated the correlation between the website and the physical store as excellent. In contrast, only 60% of them consider that ALTEX aligns its approaches with regional, European policies.

The second company surveyed, CCC, had the subject of the survey rated in the same way. Thus, the hypothesis that companies are interested in customer satisfaction was verified. Surprisingly, all respondents were satisfied with the customer orientation of their staff, with a share of 100%. In comparison to ALTEX, only 76% consider that the way and time complaints were handled was satisfactory. 92% of customers rated the link between the website and the physical shop as excellent. In contrast, only 71% of them consider that CCC aligns its approaches with regional, European policies.

The last company, H&M, had the subject of the survey rated according to the answers given by respondents. Thus, the hypothesis that companies are interested in customer satisfaction was verified. It turns out that 95% of those surveyed are satisfied with the customer orientation of their staff. Based on another assumption, 69% consider that the way and time complaints were handled was satisfactory. 96% of customers rated the link between the website and the physical store as excellent. In contrast, only 65% of them consider that H&M aligns its approaches with regional, European policies.

After completing and analysing the results of the questionnaire, it appears that the results may also have been influenced by the reputation or track record that each company has, which is why CCC is more highly regarded than the other two.

Triangulation is a method of analysis based on combining three tools to define a concept.

The triangulation for which the research was created was distinguished by the practical methods implemented: checklist, site analysis and opinion survey. Thus, their study shows that the reality through the companies' prism does not always correspond to the customer's reality or expectations.

In the picture below, called Figure 2., the triangulation is schematically represented.

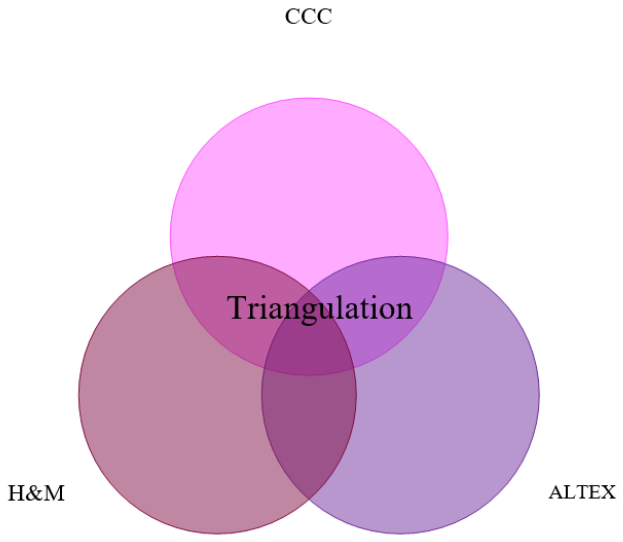


Figure 2. Triangulation representation of companies

3. Conclusions

In order to increase customer satisfaction and retain important customers, but also to remain competitive in the market, companies adopt different approaches, but they all boil down to one - customer orientation, as opposed to the traditional one - customer search. Businesses are also constantly identifying and gathering data and information about customers, thus achieving new company-wide performance.

Following the triangulation analysis based on the three companies, the following conclusions were drawn:

- the research is done by collecting data from three sources (through triangulation) ;
- no single data collection channel is used ;
- own observation validates the information gathered from the questionnaire which revealed some practices from different hypotheses ;
- institutional procedures and policies should be linked to ensure customer loyalty ;
- triangulation shows that among the three studied companies the best strategy to satisfy the customer is held by CCC.

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STRESS ANALYSIS FOR ADHESIVE BONDED SINGLE LAP JOINTS

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ABSTRACT: The analysis and modeling of an adhesive joint may include aspects of analytical, numerical and experimental studies. In this work a particular single lap joint is analyzed for two sets of adherents: aluminum alloy and mild steel and a commercial adhesive i.e. Bison for metals. First the analytical calculations are done using the classical relations of Goland and Reissner. Then, two finite element models were developed and simulated in static conditions using a linear elastic behavior of materials by Ansys code. A very good correlation of the stress distribution in adhesive and adherent were obtained using the analytical and numerical method. Finally, the same sets of adherents and the same adhesive were used to prepare specimens which were tested statically in the lab. This time the obtained results were under the expected behavior probably due to some lack of specimen preparations. Important discussions and interpretations of the results are detailed presented.

KEYWORDS: adhesive, adherents, bonded, single lap joint, finite element analysis.

1. Introducere

Glued assemblies have rapidly expanded in the transport industry with the advent of structural adhesives, i.e. with increased rigidity and strength and which successfully handle with the fatigue demands to which the resistance structure in the field of transport is subjected.

Structural adhesives are chemicals that are applied in a fluid or viscous state between specially prepared surfaces on two parts that need to be joined together. If it has been well designed and completed, the connection between the parts (adherents) is strong and durable after the adhesive has hardened. The importance of adhesives is growing because modern structures include components made of different materials that are easily and securely placed by gluing [1, 2].

The main factors that determine the integrity of an adhesive bonded assembly are [1]: selection of the most suitable adhesive, compatible with the materials of the adherents; geometry of the joint; preparation of gluing surfaces; strict quality control on the assembly line; monitoring the behavior of the joints during the operation of the products. The main advantages of using adhesives are: it is possible to harden different materials; the joint line (surface) is continuous and contributes to the stiffening of the structures as a whole; the stress distribution is more uniform than in the case of using rivets or screws; the weight of the structure increases less than in the case of mechanical assemblies (with metal fasteners); quality joints can be made both on small surfaces and on large overlapping areas; the finishing operations after the hardening of the adhesive are simple, easy to execute; proper design can ensure increased fatigue strength as well as vibration damping.

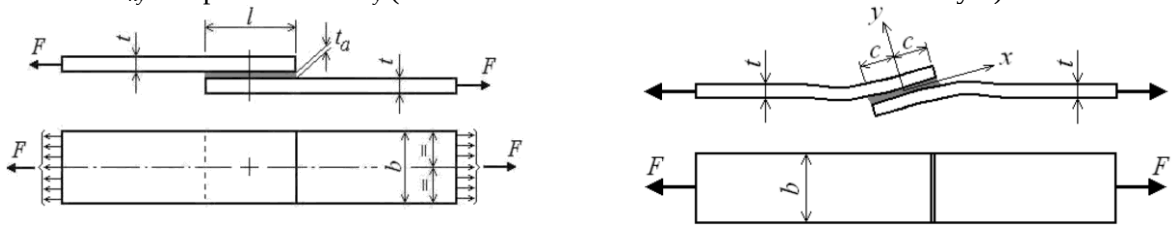
However, some limitations in the use of adhesive joints must be taken into account: choosing the right adhesive and preparing the surfaces are essential for making quality assemblies; excessive operating temperatures reduce the strength of the joints; the handling of the assembled parts must be done with special precautions during the hardening of the adhesive in order to maintain the relatively correct position; the resistance to the action of environmental factors is decisive for maintaining the integrity of the adhesive for a long time.

High strength adhesives, called structural adhesives, have shear strengths of 15 – 50 MPa, Young's modulus of 1300–4500 MPa and Poisson's ratio between 0.3 and 0.42 [1]. There are analytical relationships for design stage applicable to the most commonly used assemblies [1 – 4].

The present paper presents classical analytical relations of calculation for an overlapping glued joint. Then, for a series of specimens that were prepared and tested experimentally, the finite element method was used to verify the results obtained analytically and finally the results obtained experimentally are presented and critically discussed.

2. Analytic relations

The calculation of the bonded single lap joints can be done with several methods [4, 5], here the Goland and Reissner method was adopted [1, 6]. In Fig. 1,b the origin of the axis system is placed in the center of the median surface of the adhesive layer of thickness t_a. The overlap length is $l = 2\,c$, and the adherents are considered of the same material and with the same thickness t. The force acting on the unit of width is $p_b = F / b$. One considers elastic stresses and homogeneous and isotropic materials. For the Young's modulus and Posson's ratio, the notations E and ν are used, for the adherent material, respectively E_a and ν_a, for the adhesive. The shear modulus of the adhesive can be evaluated with the relation $G_a = E_a /[2(1+\nu_a)]$. The local bending of the adherents (Fig. 1,b) induces in the adhesive both shear stresses τ_{xy} and peel stresses σ_y (normal on the middle surface of the adhesive layer).



(a) (b)

Fig. 1. Adhesive bonded single lap joint joint. (a) geometric parameter notations; (b) the Oxy coordinate system for the analytical description of stresses in the adhesive.

For shear stresses distribution one can use the relation

$$\tau_{xy}(x) = -\frac{p_b}{8c}\left[\frac{\beta c}{t}(1+3k)\frac{\cosh(\beta x/t)}{\sinh(\beta c/t)} + 3(1-k)\right], \tag{1}$$

where

$$\beta = \sqrt{8\frac{G_a}{E}\frac{t}{t_a}}; \qquad k = \frac{\cosh(\chi c)}{\cosh(\chi c) + 2\sqrt{2}\sinh(\chi c)}; \quad \chi = \frac{1}{t}\sqrt{\frac{3p_b(1-\nu^2)}{2tE}}. \tag{2}$$

The peel stresses are described with the relation:

$$\sigma_y(x) = \frac{1}{\eta}\frac{p_b t}{c^2}\left[\begin{array}{l}\left(R_2\lambda^2\frac{k}{2} + \lambda k_1 \cosh\lambda\cos\lambda\right)\cosh\frac{\lambda x}{c}\cos\frac{\lambda x}{c} + \\ +\left(R_1\lambda^2\frac{k}{2} + \lambda k_1 \sinh\lambda\sin\lambda\right)\sinh\frac{\lambda x}{c}\sin\frac{\lambda x}{c}\end{array}\right], \tag{3}$$

where the next notations were used:

$$\lambda = \frac{c}{t}\sqrt[4]{6\frac{E_a}{E}\frac{t}{t_a}}; \qquad k_1 = \frac{kc}{t}\sqrt{\frac{3p_b(1-\nu^2)}{tE}}; \qquad \eta = \frac{1}{2}\left[\sinh(2\lambda) + \sin(2\lambda)\right]; \tag{4}$$

$$R_1 = \sinh\lambda\cos\lambda + \cosh\lambda\sin\lambda; \qquad R_2 = \sinh\lambda\cos\lambda - \cosh\lambda\sin\lambda.$$

The maximum normal stress in the adherent due to the axial force and bending moment results

$$\sigma_{ad,\max} = (1+3k)\frac{F}{bt} = (1+3k)\frac{p_b}{t}. \tag{5}$$

3. Finite element analysis and results presentation

Finite element analysis [7] allows much more accurate solutions to be obtained than analytical calculation. For this reason, a 2D plane stress model was developed for the dimension of the specimens that were prepared and tested experimentally, i.e. with two pairs of adherents: aluminum and steel (Fig. 2).

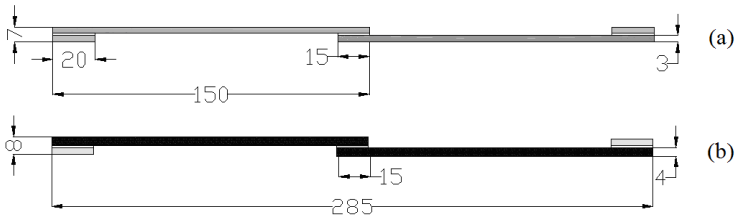


Fig. 2. Dimensions of experimentally tested specimens. The width of the specimens is b = 25 mm. (a) aluminum specimens; (b) steel specimens.

The finite element type Plane183 from Ansys was used for mesh, i.e. the quadrilateral element with 8 nodes and two degrees of freedom per node: displacements along the Ox and Oy axes. The models include over 20,000 nodes and around of 7,000 finite elements. The boundary conditions used in the simulation are specified in Fig. 3 and correspond to those in the experimental tests. The thickness of the adhesive was considered t_a = 0.5 mm and it was discretized much finer than the adherents. Because the numerical model is linear, the value of the load force F is not very important for stress distribution calculations. For both finite element models the same load F = 1 kN was chosen. The elastic material constants used in modeling are given in Table 1.

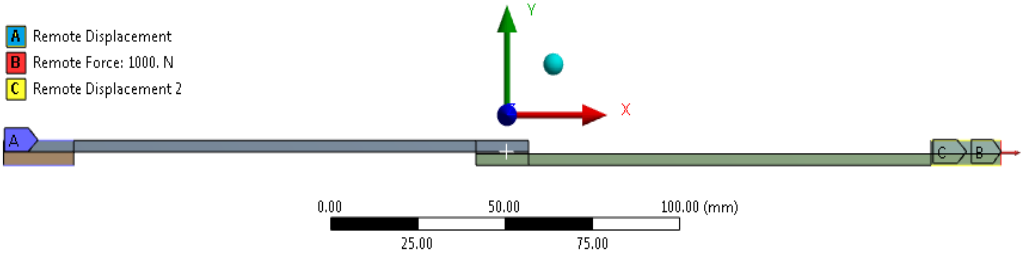


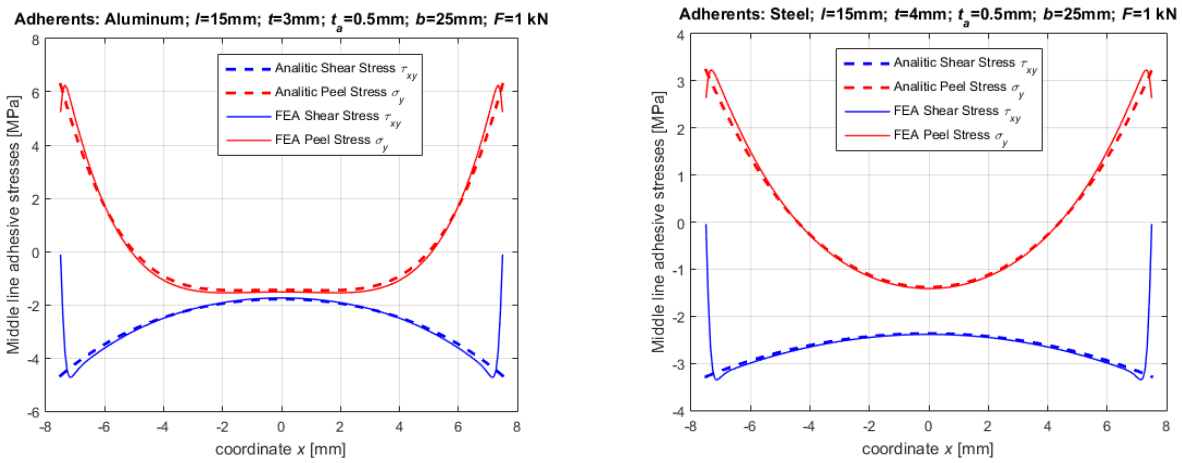
Fig. 3. Boundary conditions (load and supports) considered in the finite element models.

Table 1. Elastic properties of the materials.

Material	Young's modulus E [GPa]	Poisson's ratio ν [-]
Steel	200	0.3
Aluminum	70	0.33
Adhesive	1.85	0.38

The stress results in the median plane of the adhesive, obtained with the two developed finite element models, as well as the analytical ones using the relations (1)–(4) are presented in Fig. 4. The Matlab program was used to process the analytical relations. It is observed that the stress distribution obtained analytically is very close to the distribution obtained with the finite element method, which is considered more accurate in this case.

Using the relation (5), and the results obtained from the finite element analysis (FEA), respectively, in Table 2 the maximum stresses in the adherents, in the vicinity of the adhesive are presented. The probe stress in the finite element models was read at a distance t_a from the ends of the adhesive to remove the stress singularities at the adhesive roots.



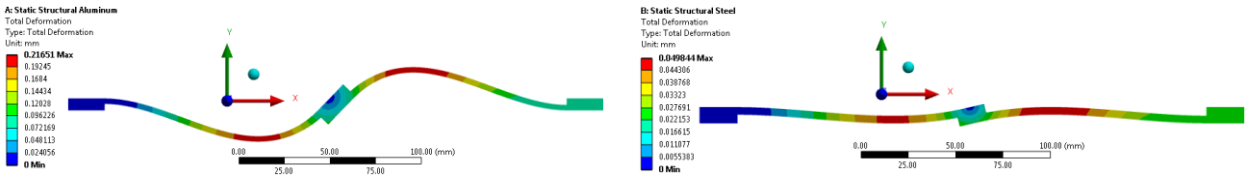
(a) (b)

Fig. 4. Distribution of stresses in the median plane of the adhesive obtained analytically and with the finite element method for F = 1 kN. (a) aluminum adherents; (b) steel adherents.

Table 2. Maximum normal stress (in MPa) in the adherents: $\sigma_{ad,\max}$ when F = 1 kN.

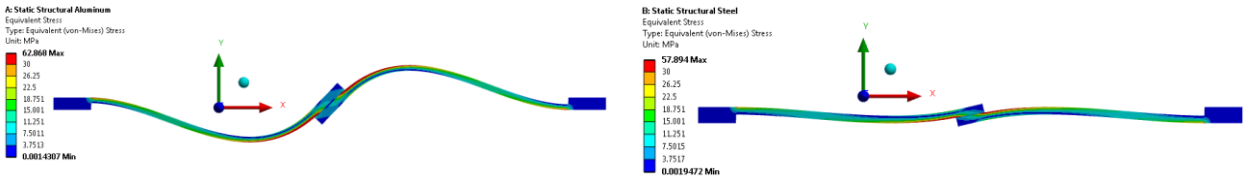
Adherents	Analytic, relation (5)	FEA results in vicinity of adhesive layer (see Fig. 1,b)	Relative error [%]
Aluminum - Aluminum	49.3	53.1	7.15
Steel - Steel	38.7	40.3	3.97

The total displacement distributions and the deformed shapes of the finite element models are presented in Fig. 5. The von Mises stress distributions, including also the stress singularities, are accessible in Fig. 6. Here one can clear observe the location of the maximum normal stress in the adherents. In Fig. 7, the von Mises stress distributions are presented only in the adhesive. Here it is very clear to observe some stress singularities at the ends of the adhesive layers.



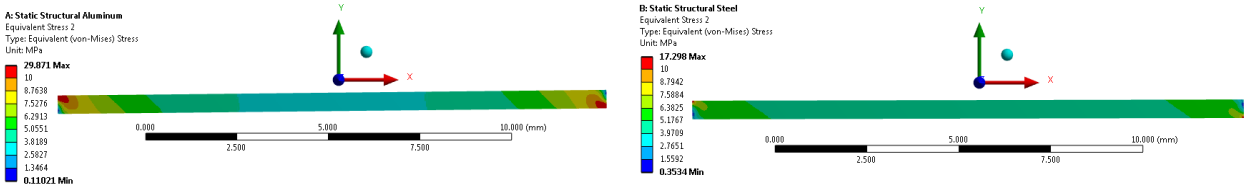
(a) (b)

Fig. 5. Total displacement distributions if F = 1 kN. The deformed configuration is 100 times larger than the real ones. (a) aluminum adherents; (b) steel adherents.



(a) (b)

Fig. 6. Von Mises stress distributions if F = 1 kN. (a) aluminum adherents; (b) steel adherents.



(a) (b)

Fig. 7. Von Mises stress distributions in adhesive only if F = 1 kN. (a) aluminum adherents; (b) steel adherents.

4. Experimental results

The experimental part focused on how to perform a laboratory test, following steps such as: procuring, cutting the material, removing burrs, sanding and decontamination of the surface, applying wax strips to maintain a 0.5 mm thick layer of adhesive, mixing and application of the two-component adhesive (BISON brand), pressing and curing time (48 hours in this case).

The static tensile test was performed at a speed of 1 mm/min using a Zwick Roell universal testing machine (Fig. 8) from a mechanical testing laboratory in the Strength of Materials department. Two sets of test pieces (specimens) were prepared and tested, each set consisting of three specimens. The lower end of the specimens is fixed and the traction force is applied to the upper one. The traction force and the displacement of the moving end are recorded during the tests. For the six created specimens, the characteristic curves are presented in Fig. 9. There is a relatively large dispersion of the results and the fact that the steel specimens take to a higher force than the aluminum ones. The maximum values of the registered forces, as well as the displacement of the free end at the moment of break are presented in Table 3.

Table 3. Experimental results

Adherents	Specimen No.	Global results	
		Maximum force [N]	Maximum displacement [mm]
Aluminum - Aluminum	1	1350	1.8
Aluminum - Aluminum	2	1350	1.3
Aluminum - Aluminum	3	359	0.8
Steel - Steel	4	1710	2.0
Steel - Steel	5	987	1.7
Steel - Steel	6	1800	2.2

The appearance of the specimens after the test is shown in Fig. 10, where it is observed that all breaks occurred by peeling off the adhesive from one of the adherents, which shows poor adhesion of the adhesive to the metal or the glued surfaces were not sufficiently well prepared for gluing.

Based on the characteristic curves obtained in the laboratory, a series of conclusions were drawn regarding the behavior of the adhesive. The characteristic curves obtained experimentally are similar to those obtained for textile yarns, i.e. hardening when the load increases. This apparently bizarre behavior may be due to the behavior of the adhesive in relatively low strength tests or other aspects unknown at first glance, which is why the tests should be repeated and optically monitorized.

Fig. 8. Zwick Roell universal testing machine with aluminum-aluminum test specimen fitted for tensile testing.

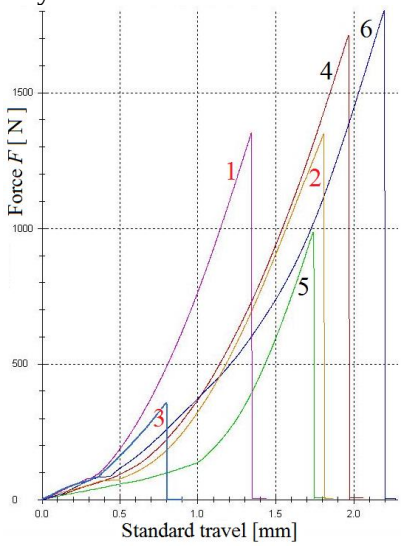
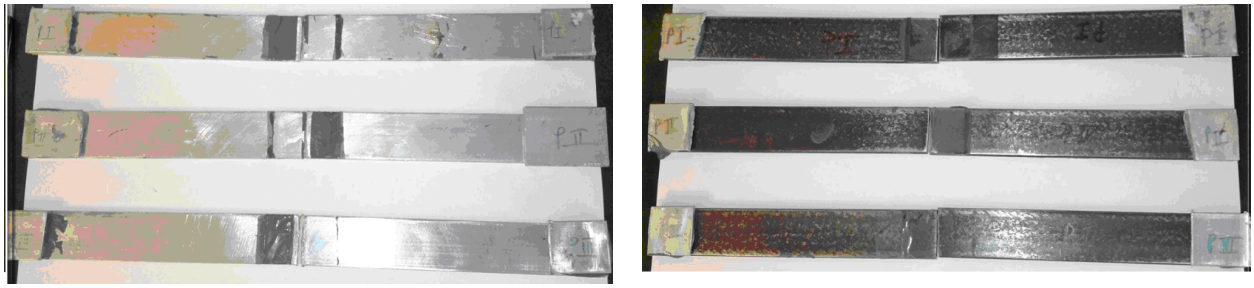


Fig. 9. The characteristic force-displacement curves obtained for all specimens tested. The figures next to the curves represent the test specimens according to Table 3.



(a) (b)

Fig. 10. Aspect of adherents after testing. (a) aluminum adherents; (b) steel adherents.

5. Conclusions

The study conducted in this paper shows that the Goland and Reissner relations [6], although obtained in 1944, can relatively correctly estimate the stress distribution and their maximum values.

Relatively rigid adhesives, which are marketed for individual use, in this case Bison [8], are not accompanied by all the elastic characteristics required in the calculation. For the two-component adhesive used in this paper, the manufacturer gives some more qualitative technical specifications. An adhesive strength of up to 22 MPa is guaranteed in the specifications without specifying the load type. Previous tests performed in the laboratory allowed partial characterization of this adhesive type and the data were used in modeling. However, for the tests performed and presented in this work, if the maximum strength obtained for the steel specimens F_{max} = 1.8 kN is considered, then for the shear area A_f = 15·25 = 375 mm^2, an average shear stress of 4.8 MPa results. This value is much lower than 22 MPa, but the yield for the tested specimens was not in the median plane of the adhesive, i.e. it did not yield but simply debonds because the adhesive does not have very good adhesion to metals. However, further investigation is required for extensive characterization of this adhesive.

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SMALL-SCALE ENERGY STORAGE SYSTEMS

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Summary: Electricity generation has lately become more accessible than ever before, but its storage is becoming an increasingly acute issue. Current energy storage technologies have become more and more inaccessible over time, involving limited natural resources, high production costs, declining practical use, and an acute problem in terms of storing and recycling after use. Small-scale energy storage systems are meant to solve these emerging problems, as an alternative to traditional batteries. Molecular solar thermal systems - MOST - is a technology that allows the storage of solar energy through photo-switchable molecules, which once exposed to the sun, end up getting an electric charge. Even though this technology is at an early stage, research has shown its usefulness as an effective solution to the above problems.

KEY WORDS: energy storage, solar energy, molecular system, photo-isomer.

1. Introduction

Following the 2015 "Paris Agreement", 195 states responsible for 99.75% of global greenhouse gas emissions have committed to keep the average global temperature rise in this century below 2°C above pre-industrial levels, aiming to limit this rise to 1.5°C. Electricity generation, storage and climate change are closely linked, thus, counteracting the threat posed by climate change requires radical renunciation of the current energy system, dependent on fossil fuels, and of energy storage in traditional batteries. In order to achieve the targets and objectives in terms of greenhouse gas emission, these sectors need to increasingly use renewable energies and new technologies for storage of energy from alternative sources.

Solar energy can also be stored naturally, through photosynthesis, but with an extremely low efficiency, up to 0.3%. An alternative way for storing solar energy is storage by using photo-switchable molecules, a concept introduced back in 1909. Since the concept of solar energy storage was introduced, a series of photo-switchable molecule systems were developed. These energy storage technologies are called ***Molecular solar thermal systems (MOST).***

2. The current stage

Although the cost of renewable energy, such as wind or solar energy, has relatively fallen compared to a few years ago, energy storage is still becoming more expensive. Renewable energy is not always available, as it exists either when the sun shines or when the wind blows, therefore, storing energy for other situations is essential. The most used types of batteries are lead-acid and lithium-ion, with a wide applicability nowadays. New versions of these technologies are being

developed, however their use is becoming more and more difficult over time. Along with the fact that a multitude of natural resources are used in manufacturing, which end up being exhaustible in time, and the relatively large size of batteries, the biggest current problem is storage when they are out of use, given that now they cannot be recycled and reused.

3. The problem subjected to the analysis

The current challenge is to manufacture energy storage devices not only as small as a microchip, but also to develop energy storage devices that are part of a microchip, easy to integrate into the current chip manufacturing processes. The miniature technologies come as an efficient energy storage solution, primarily due to their low weight, good density (volume/capacity ratio) of stored energy and longevity. The use of photo-switchable molecules as a method for energy storage is a technology that involves elements of a very small size, which can be easily integrated into microchip systems and which can be used particularly for storing solar power.

4. Theoretical issues

One of the innovative miniature technologies for solar energy storing is the *MOST* concept. So, following three stages that take place, a cycle of operation of the system is formed, namely energy storage. The steps are as follows:

1. Photonic stimulation;
2. The transition of the molecule to its photo-isomeric state;
3. The opposite process, triggered by a thermal or catalytic stimulus, of return of the molecule to its initial state (heat release).

The repetition of these successive stages ensures a cyclical deployment of the energy storage-use process. The process of energy storage takes place under the action of sunlight and, through the process of photo-absorption, the molecule of the system passes from the normal state to the stimulated state, determined by the penetration of photons into the molecule. Due to this stimulation, the molecule passes, as a result of a photo-conversion process, to its photo-isomeric state. In order to release the stored energy by the means of a thermal or catalytic process, an opposite process of conversion from the photo-isomeric state to the initial state is intentionally triggered. During this process, heat is released, which can be converted into electricity by the means of a generator.

In order to ensure the effective storage of energy, the molecule must be maintained in its photo-isomeric state, keeping its enthalpy below the barrier of triggering the opposite photo-conversion process of transition to the initial state. At the same time, in order to have a considerable energy storage capacity, the barrier of the process of passing the photo-isomer into the initial state must have values much higher than the enthalpy of the molecule in the initial state. In addition, the molecule must withstand a series of such cycles in order to be efficiently reused for energy storage. At the same time, the molecule must be able to absorb a spectrum of as many photons as possible in order to be able to take up much of the photon flux brought by sunlight, what will increase the use of the exposed solar energy. The system’s molecules can also exist in an

environment formed by a solution with a special chemical composition, through which it will be able to foster the efficient development of the processes that take place.

Thus, it results that the functionality and the efficiency of a *MOST* system largely depends on the molecule underlying the system. So, in order to obtain an efficient *MOST* system, we must start from a molecule that best meets the criteria set out above.

A series of eligible molecules have been identified to form an efficient *MOST* system. They are usually noted together with the name of their photo-isomeric state. Two of the best-known molecule/photo-isomer pairs used in the experiments with *MOST* systems are: azobenzene – E/Z (E/Z - AZO), norbornadiene/quadricyclan (NBD/QC).

The first pair listed above, azobenzene - E/Z (E/Z - AZO), is a *MOST* system in which the initial molecule, to be subjected to solar radiation, is in fact also an isomer (azobenzene - E), which, by photon absorption, passes into another meta-stable photo-isomeric state (azobenzene - Z), much more energetically charged than the initial state. However, this combination is more difficult to apply, because the opposite transition, from state Z to state E, is easily triggered by exposure to light, which means that heat can be unwantedly released, so there is a higher risk of loss of stored energy.

The norbornadiene/quadriciclan (NBD/QC) pair was introduced between 1958 and 1961. Over time, great efforts have been made to increase the performance of this pair, but it still has a main unresolved disadvantage: norbornadiene can only absorb the spectrum of ultraviolet rays, so it cannot absorb all the energy emitted by the sun's rays. However, it has an advantage over the E/Z - AZO pair due to the inactivity of the quadricyclan photo-isomer under the action of solar irradiation, so the risk of potential unwanted energy loss is excluded, if the system remains exposed to light action after energy storage.

4. Development of miniature energy storage technologies

Although no highly efficient molecule to store all solar energy has been found yet among all the pairs eligible to form the basis for *MOST* systems, new and new experiments are being done to develop functional and really efficient solar energy storage technologies through *MOST* systems. Thus, in 2018, researchers at Chalmers University of Technology in Sweden revealed to the world their invention, the so-called "fuel liquid" [4]. It is based on the molecule shown above, norbornadiene (NBD). This "fuel liquid" is in fact a *MOST* system and it operates based on the same principles and can store solar energy for up to 18 years.

In order to use the stored energy, a reaction for transition to the initial state is triggered by the means of a cobalt-based catalyst. The researchers estimated that, in the isomeric state of norbornadiene, the quadricyclane (QC), the liquid can store 250 Wh (watt-hours) per kilogram. The advantage of the invention of Chalmers researchers is that the system supports a very large number of energy storage-use cycles. According to researcher Kasper Moth-Poulsen [4], their *MOST* system went through 125 such cycles without any significant degradation of the system.

The fuel liquid developed by Chalmers researchers opens wide opportunities for use in the industry and even in the life of the average consumer. For example, such a system can power a heating system for a living area, based entirely on energy from the sun's rays (Chart 1). In addition,

the researchers of fuel liquid succeeded to renounce the flammable solution. So, the toluene, in addition to being a system with zero pollutant emissions, is also a very safe system.

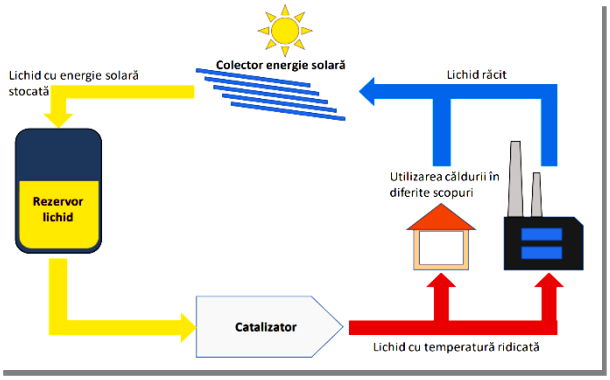

Chart 1 *Scheme of the use of solar energy stored by a MOST system*

This year, researchers at Chalmers University of Technology succeeded to transform the chemical energy stored in their *MOST* system into electricity. This transformation was accomplished by the means of an extremely small heat generator, which could be "integrated into electronics, such as headphones or telephones" [4], according to this university's researcher, Zhihang Wang.

Although the Chalmers research team brings very promising solutions in terms of zero-emission energy technologies, there is still a long way to go in order to bring the *MOST* system to the best possible cost-effectiveness ratio, so that it can be applied on a large scale.

5. Conclusions

In conclusion, we can say that miniature electricity storage devices have proven their applicability and usefulness, especially in a society in continuous digitalization. At the same time, the small size and the relatively low resources required for production make these technologies cost-effective and widely applicable in the digital device manufacturing sector. Even though there is a long way to go until they are integrated as basic elements of some devices, research shows that these systems will be found in many electrical devices of the future.

The molecular solar thermal system is one of the solutions that allows the storage of energy in miniature components, making possible the storage of relatively large electrical charges compared to the size. The main purpose of this miniature energy storage technology is to provide efficient and environment-friendly possibilities for the storage of energy from alternative sources to fossil fuels, a rapidly developing energy sector. The second important goal of *MOST* systems is to replace the traditional batteries with alternative miniature technologies, which do not pollute the environment and which, when out of use, can be recycled. At the same time, the integration of this technology in mass consumption will further enhance the global development of the energy sector due to alternative energy sources. So, *MOST* systems could be one of the technologies that will move humanity away from the old energy system, a major cause of global pollution, and from the traditional batteries, towards alternatives with better prospects.

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THE IMPLEMENTATION OF INDUSTRIAL ROBOTS

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ABSTRACT: Progress is nothing new, especially from a scientific point of view. Many would argue that we are now in Industry 4.0, the fourth Industrial Revolution, due to the rapid digitalization of the world. We covered the historical context that justifies our current need for industrial robots, arguing about the benefits and disadvantages of their implementation. After a short discussion about 'Smart Factories', we classified the industrial robots, choosing to detail the industrial robot SCARA, drawing and explaining the advantages of its kinematic scheme.

KEYWORDS: industrial robot, Smart Factories, SCARA robot, kinematic structure.

1. Introduction

In the paper the subject is debated at length, focusing on the remarkable progress of technology, showing that mankind has always invented better and better means to meet their needs. All that is presented leaves room for the question "what will happen next?"

2. Current status of industrial robots

Presentation of the history behind industrial robots and the advantages and disadvantages of large-scale implementation. What is a "Smart Factory" and the classification of industrial robots.

2.1 The historical context of robot deployment

In many ways, throughout history, humans have created various ingenious solutions to simplify their daily tasks. This simple but remarkably human fact has caused significant changes in our lifestyle, and we can say that it has directly helped our evolution as a species.

A first change of this kind, and the first time man used anything but his own hands and physical exertion was more than 10,000 years ago, when man transitioned from hunting / searching for food to raising it in a farm. Slowly, the quality of human life increased, no longer needing to lead a nomadic lifestyle, pursuing food - cities and settlements were formed, all through human ambition and insight.

With the Second Industrial Revolution, which began in the 19th century and ended in the early 20th century, mass production in factories became possible thanks to electricity, the scientific progress of that period, and the invention of the assembly line. The assembly line was invented by Henry Ford in 1913, and once installed, it was able to reduce the assembly time of a machine from 12 hours to one hour and 33 minutes. The third Industrial Revolution, also called the Digital Revolution, began in 1960 and was characterized by the construction of the first computers and later, in 1990, the Internet.

Since 1980, the interest of large manufacturing companies for robots has begun to grow exponentially. Yaskawa America Inc. introduced the Motoman ERC control system in 1988 to work in one of their assembly plants. It had the power to control up to 12 axes, which was the largest possible number at the time. In 1994, the Motorman ERC system was upgraded to support up to 21 axles, and in 1998, 27 axles. The controller could also operate up to 7 robots, used in form cutting (laser cutting or high pressure water cutting) the task considered by Yaskawa America to be far too dangerous for humans.

In December 2008, Linatex, a Danish supplier of plastics and technical rubber for industrial applications, purchased a new UR5 robot (made by Universal Robots) to automate the operation of CNC machines, which they installed next to the company's employees, without using a safety grille, as usual. Instead of bringing in an external programmer with complex programming skills, Linatex programmed the robot themselves, using a touch screen, with no programming experience. With the launch of UR5, Universal Robots became a major player in industrial automation, paving the way for new frontiers, with a particular focus on small and medium-sized businesses, where the use of robots was usually too expensive and complex. With more than 8,400 robots now installed in more than 55 countries, the company has successfully entered markets that require flexible and easy-to-use robots that can work with employees safely.

We consider, therefore. that we are in the 4th Industrial Revolution, due to robots and the rapid advancement of technology, and that the implementation of industrial robots will have as much significance for humanity as the invention of the train rails of the first industrial revolution.

2.2 Smart factories

The term 'Smart Factory' was first used at the Hannover Fair in Germany, 2011. A Smart Factory is a unit based on intelligent/automated production and although this concept is still in its infancy, it is considered the result of the Fourth Industrial Revolution, known as Industry 4.0. Smart factories use the latest technologies in areas such as artificial intelligence, robotics, analytical tools and IoT - 'Internet of Things', a term that refers to billions of devices around the world connected to the Internet and permanently stored in a collection process. and data exchange. This type of factory is designed to operate autonomously with minimal human intervention, requiring people only for maintenance and inventory, and, of course, in managerial positions. In conclusion, the implementation of robots in factories to such a high degree could positively influence the quality of human life, replacing people in hazardous areas or with unfavorable conditions, performing repetitive tasks and actively preventing their exploitation.

2.3 The advantages and disadvantages of implementing industrial robots

Advantages:

1. increased quality consistently: Like other technologies such as the above-mentioned "Internet of Things", industrial robots are able to provide a better quality of production, through precision. A great benefit to this is the ability to monitor robots in real time, effectively preventing any mistakes.

2. Increased productivity: An industrial robot greatly increases production speed, in part due to the fact that it works non-stop, requiring no breaks or shift

3. Provide human safety: We consider this to be the most important advantage - using robots for repetitive tasks means less risk of injury to workers, especially if manufacturing takes place in a hostile environment.

4. Lowering wage costs: Paying a person often costs more than a robot and maintaining it. The base can guide them to parts of the business where their unique skills can be better used, such as in engineering, programming and maintenance.

Disadvantages:

1. Requires a large initial investment: Industrial robots usually need a generous initial investment to cover installation and configuration costs, since many current industrial robots are no longer as simple as UR5.

2. Permanent costs: Robots need maintenance, but not only. In addition, the protection of robots and associated devices through the "Internet of Things" from cyberthreats also imposes a cost.

3. Leaving the middle class out of work: This aspect is also important to consider (although this paper is not, per se, about this theory): If the jobs to which workers are heading are not as well paid or require education at which they did not have the privilege of taking part? We cannot be convinced that the company he works for will provide them with courses or opportunities that will provide him with at least as beneficial a job.

2.4 Classification of industrial robots

Depending on the type of movement, industrial robots can be:

1) **Cartesian robot**: also called rectilinear, its arm operates in a space defined by Cartesian coordinates (x, y, z), which means that it moves in straight lines, translation on 3 different axes. Cartesian robots have very flexible configuration models and are a popular choice for building CNC and 3D printing machines.

Fig. 1. The Cartezian robot

2) **SCARA robot**: SCARA = Selective Compliance Assembly Robot Arm. Similar to the Cartesian ones, SCARA robots operate on the x, y and z axes but also have rotational motion. SCARA robots are excellent for lateral movements and are used in assembly and biomedicine.

Fig. 2. SCARA robot

3) **Cylindrical robot**: Cylindrical robots have a rotating joint at the base and a prismatic one for connecting the arm that moves in translation. Due to their compact design, they are most often used in painting or repairing cars.

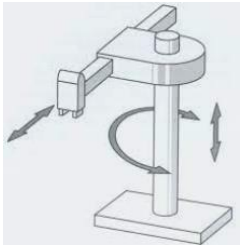

Fig. 3. The cylindrical robot

4) **Delta robot**: also called the parallel robot, it has 3 arms fixed to the same base mounted above the workspace, each arm having a joint between the effector that allows it to work precisely, delicately, but also incredibly fast. Delta robots are predominantly used in the pharmaceutical and electronics industries.

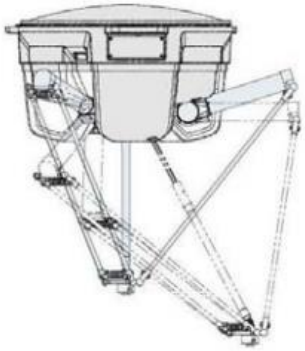

Fig. 4. Delta robot

5) **Polar robot**: nicknamed the spherical robot, they have an arm with 2 rotating joints and a translation arm, connected to a twisting base. The robot's axes together form polar coordinates, allowing the robot to work anywhere in its sphere. They are usually used in metal welding and injection molding.

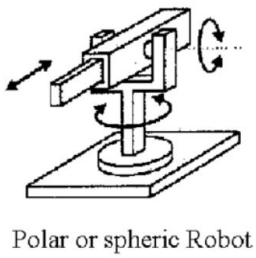

Fig. 5. The spherical robot

3. The SCARA robotic arm

Next, we will deepen the subject of the robotic arm of SCARA type robots.

YAMAHA - a multinational company of Japanese origin known as one of the largest motorcycle manufacturers in the world - attributes part of its success to the market of the SCARA type robots they use: YK-XG Series. Their robotic arm can operate at lengths between 120mm and 1200mm and can support

weights between 1 kg and 50 kg. This robot is used in a wide variety of processes and applications, such as production equipment for electrical and electronic components and small precision machine components that require precise assembly and assembly, handling and transfer of large automotive components.

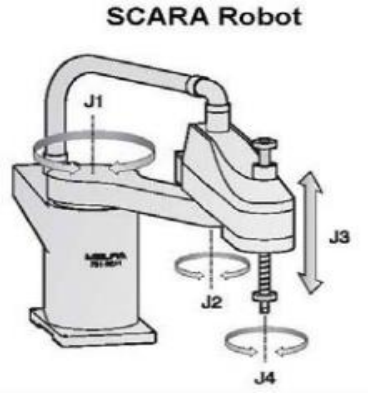

Fig. 6. Operating principle

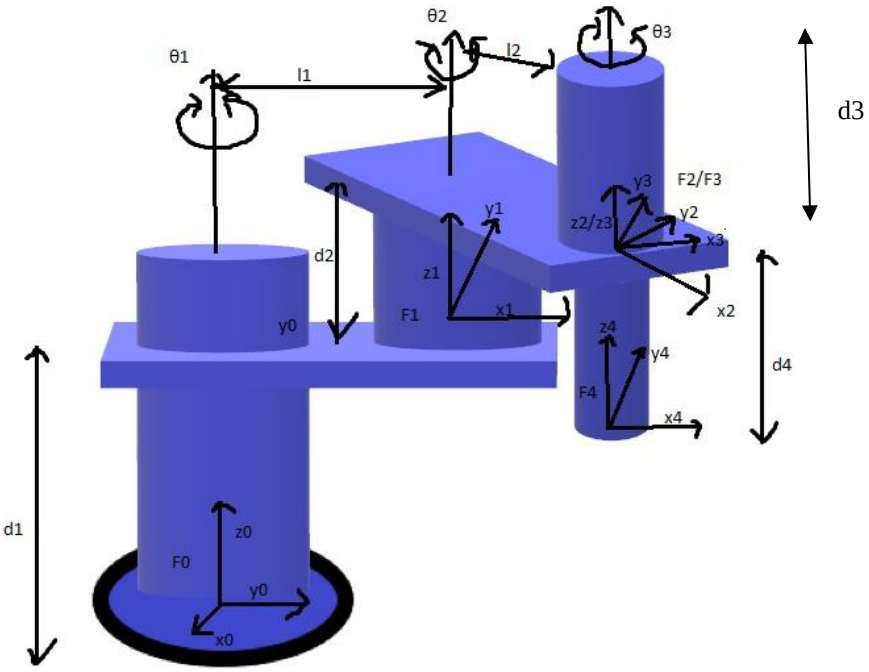

Fig. 7. Kinematic structure of the SCARA robot

We can see that the SCARA robot has 3 rotating joints, rotating at angles Θ1,2,3 and can perform 3 independent rotational movements with respect to each other (RRR), having 4 degrees of freedom.

We can analyze the movements of the robot knowing the movements of each coupling of the SCARA robot. For this we will use the Denavit-Hartenberg (DH) parameters entered in MATLAB. Knowing these parameters we can determine the position of the end-effector.

"Li" is the distance between the z-axes measured along x ; "αi" is the angle at which the system i-1 must be rotated in respect of x so that day-1 reaches z ; "di" is the distance between the x-axes measured by z.

Tabel 1. The SCARA robot parameters

	Variable arms	**αi**	**αi**	**di di**	**αi -d3**	**sin θ1**
1	θ2	0	L1	0	1	0
2	L2	0	θ3	0	1	0
3	d3	0	0	-d4	1	0
4	0	0	0	ai	1	:

DH matrix has the following forms:

$$\begin{pmatrix} \cos(\theta 1) & -\sin(\theta 1) & 0 & L1\cdot\cos(\theta 1) \\ \sin(\theta 1) & \cos(\theta 1) & 0 & L1\cdot\sin(\theta 1) \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} \cos(\theta 2) & -\sin(\theta 2) & 0 & L2\cdot\cos(\theta 2) \\ \sin(\theta 2) & \cos(\theta 2) & 0 & L2\cdot\sin(\theta 2) \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -d3 \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} \cos(\theta 3) & -\sin(\theta 3) & 0 & 0 \\ \sin(\theta 3) & \cos(\theta 3) & 0 & 0 \\ 0 & 0 & 1 & -d4 \\ 0 & 0 & 0 & 1 \end{pmatrix} \quad (1)$$

$$\begin{pmatrix} \cos(\theta 1 + \theta 2 + \theta 3) & \sin(\theta 1 + \theta 2 + \theta 3) & 0 & L2\cdot\cos(\theta 1 + \theta 2) + L1\cdot\cos(\theta 1) \\ \sin(\theta 1 + \theta 2 + \theta 3) & \cos(\theta 1 + \theta 2 + \theta 3) & 0 & L2\cdot\sin(\theta 1 + \theta 2) + L1\cdot\sin(\theta 1) \\ 0 & 0 & 1 & -d3 - d4 \\ 0 & 0 & 0 & 1 \end{pmatrix} \quad (2)$$

4. Conclusions

- We explained the historical context of people's need for industrial robots.
- We have exemplified the advantages and disadvantages of their implementation in factories, mentioning smart factories.
- We classified, according to the type of movement, the industrial robots, choosing the SCARA robot for detailing.
- Making a kinematic structure of a SCARA robotic arm, we detailed the robot main parameters and gave the final form of the Denavit-Hartenberg matrix.

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ACCREDITATION OF MEASUREMENT LABORATORIES

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SUMMARY: The scientific work entitled "Accreditation of measurement laboratories" is based on a list of questions (checklist) created using the ISO 17025: 2005 standard which is implemented in an accredited laboratory. The study is conducted in a laboratory called "Laboratory for Food Safety" based on the determination of heavy metals, pesticides and antibiotics in food and water and in a wood compression testing laboratory within ICECON, accredited by RENAR, the only company in Romania that does this.

The results and conclusions we have reached are presented in the scientific work.

KEY WORDS: accreditation, laboratory, procedures, accreditation bodies, calibrations.

1. Introduction

The attestation by a third party represents the accreditation, that is it the official approval that a body is totally competent to accomplish specific conformity evaluation tasks

Accreditation is important for the legalization of laboratories, such as: it gives trust in the technical competence, objectivity and uprightness of bodies and laboratories that achieve conformity assessment, contributes to increasing the competitiveness of products and services, in the context of globalization of markets, contributes to promoting the free movement of products and services, it means also the promotion of safety regards life, individuals and health.

The objectives of paper entitled "Accreditation of measurement laboratories" are to follow the requirements of ISO 17025: 2005 "General requirements for the ability of testing and calibration laboratories" implemented in various testing and calibration laboratories accredited by accreditation bodies in Romania. The objectives are achieved through a list of questions to which we have obtained answers from qualified UPB and ICECON qualified staff in this field.

2. Trends / Perspectives

In Romania, there is a law for the accreditation of measurement laboratories, Law 608/2004, which generated both regulations and the creation of bodies capable, legally and competently, to evaluate and give the vote of confidence to the product.

The ISO 17025: 2005 standard covers all the conditions that testing and calibration laboratories must meet if they want to prove that they are operating in accordance with a quality model, that they are technically capable and that they are able of producing technically reliable results.

Currently, in Romania, accreditation of testing laboratories is done conformable with SR EN ISO 17025 of 2005, entitled "General requirements for the competence of testing and calibration laboratories", which specifies the conditions that a laboratory must meet to be recognized by the competent bodies.

Accreditation bodies that admit the ability of testing and calibration laboratories should use this European standard as a foundation for their accreditation.

Issues that directly affect data quality and technical competence in laboratories are addressed in ISO 17025.

The use of International Standard SR EN ISO 17025: 2005 clear the way for collaboration between laboratories and other bodies and will help to exchange information and experience, as well as to harmonize standards and procedures.

3. Implementation of conditions of the SR EN ISO 17025: 2005 standard in accredited laboratories

3.1. Implementation of conditions of the SR EN ISO 17025: 2005 standard in food safety laboratory within UPB

The National Center for Scientific Research for Food Safety (CNpSA) is based on the arrangement of 5 laboratories within the CAMPUS-UPB complex, including the Laboratory for Food Safety (LpSA), having in its composition 4 other spaces that allow taking over a larger volume of evidence, increase the beneficiaries' confidence in the results obtained and interlaboratory validation of the results obtained.

The spaces where the activities within LpSA are carried out are: Sample Preparation Laboratory, Advanced Separation Laboratory, Spectroscopy and Spectrometry Laboratory, Complex Thermal Analysis Laboratory. LpSA was accredited to ISO 17025 in July 2021, currently having all the necessary resources to carry out its core business.

The analyzes that are done in the laboratory are: determination of pesticides, determination of heavy metals, determination of antibiotics in food, being sensitive methods that require extraordinary attention to detail.

From the analysis performed, it turned out the conditions of the standard SR EN ISO 17025: 2005 are met.

Comments on the implementation of the requirements of the above standard are:

- the management staff and the technical staff have the authorization and the necessary resources to carry out the tasks;

- there are detailed policies and procedures regarding the performance of laboratory tasks;

- the management system of the laboratory is adequate to its activity system;

- within the laboratory, there is a quality manual and a policy statement;

- there are procedures for analyzing requests, offers and contracts;

- periodic internal audits are performed in the laboratory;

- by means of an devicess, the laboratory supervises, manages and records the environmental conditions as needed by the relevant specifications (laboratory humidity must be approximately 45 ± 10%);

- the methods developed in the laboratory are adequate and efficient;

- the laboratory is equipped with the necessary equipment to perform the activity correctly;

- each piece of equipment is calibrated before it is put into service;

- there is a form for reporting the results obtained in the laboratory;

- the staff is properly qualified and trained, constantly participating in specialized courses.

The importance of this laboratory can be identified in the following concrete example of the last analysis performed in the accredited laboratory of the UPB faculty.

Specifically, the synthesis of a magnetite that has been loaded with an active substance called curcumin. Curcumin is a substance that has an anticancer, antioxidant activity and can be used to treat bone cancer. The idea of the analysis was to note that the active substance can be released on a regular basis over a longer period of time. After loading the material, it was introduced into a solution called SBF (simulated body fluid), taking samples at intervals to observe the evaluation of the curcumin released on the functional support. This analysis was performed by a UV-VIS spectrophotometer. Biocompatibility was taken into account. In this accredited laboratory, in vitro tests with antimicrobial purpose are also performed for dressings, wounds, burns.

For the part of the uncertainty that may appear in the examination samples, the cause-effect diagram is used to detect all sources of uncertainty that may affect the sample from several points: environmental conditions (t°, humidity), instruments used (pipette), method analysis, etc.

The following figure shows the cause-effect diagram for identifying origins of uncertainty in the food safety laboratory.

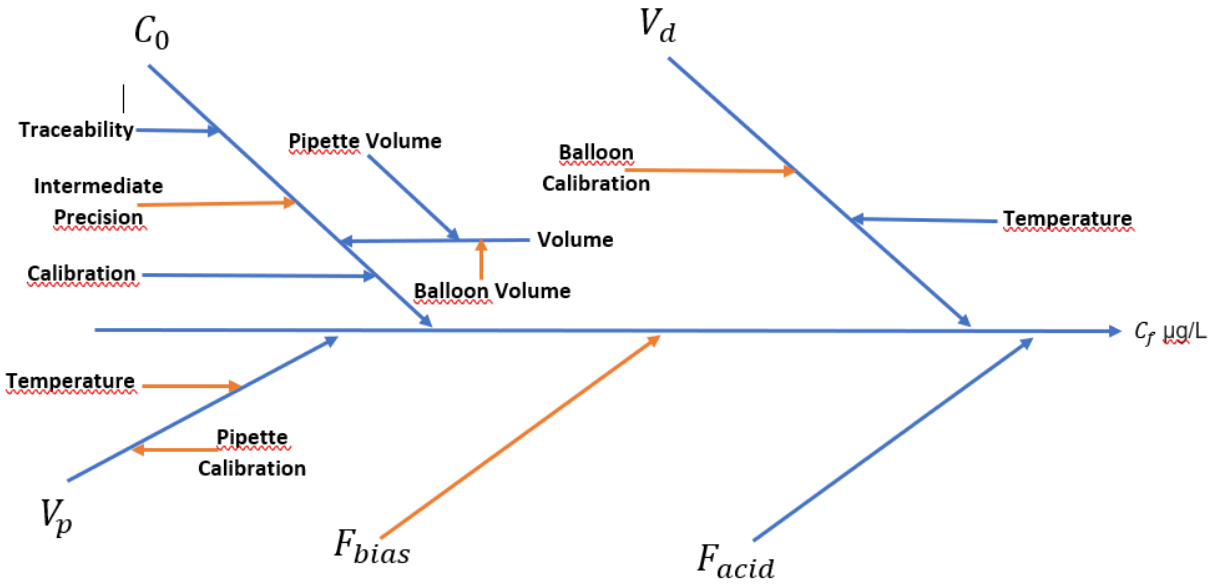


Figure 1. Ishikawa diagram-Identifying sources of uncertainty when analyzing evidence

F_{bias}=bias factor; F_{acid}= acid factor; V_p=initial test volume;

C_0= concentration read on the calibration curve; V_d= the volume of the volumetric flask used for dilution.

3.2. Implementation of the requirements of the standard SR EN ISO 17025: 2005 in laboratory of analysis and testing in constructions within ICECON

The Research Institute for Equipment and Technologies in Construction (ICECON S.A.) operates in the field of technologies and equipment for mechanization of works and installations, conducting scientific research in construction.

Examples of RENAR accredited tests performed at ICECON S.A.

- determination of burglary resistance;

- fatigue test;

- test for resistance to repeated compressive loads;

- test at high stresses in the mechanical joint with a small number of cycles;

- determination of flue gas emissions (O2, CO, CO2) and flue gas temperature;

- determination of frost-thaw resistance for concrete;

- determination of plastic deformation capacity - Bending test;

- shear test;

- determination of the mass per unit area;

- determination of the film thickness;

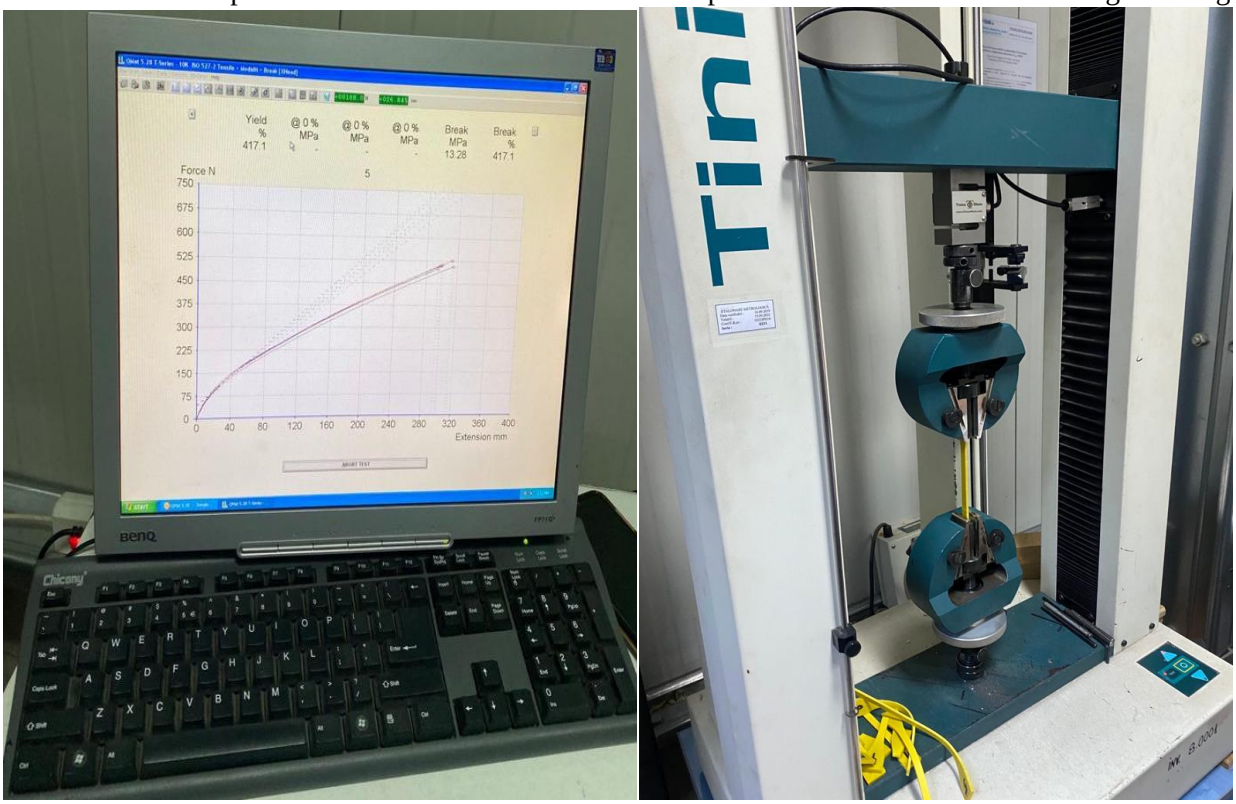
- determination of bending and compression strength;

The case study conducted at ICECON S.A. was largely based on the list of quality system documents, which includes system procedures and test procedures.

Regarding the ISO 17025: 2005 standard documentation, the requirements are successfully met, the analysis shows that the quality management system is established in conformity with the conditions of the standard, the processes and all applications required by the management system are defined, process interaction has been identified, criteria and methods needed to ensure efficient operation and process control have been established, Quality Management System documentation covers quality policy and quality objectives prepared, quality book, reported processes required for the system, there is a manual quality prepared and maintained, management review is documented.

In the laboratory, the deformation of an elastic body was observed, during the compression test on wood.

The result reached is the determination of the maximum compression limit (σ_a = 100 daN / cm ^ 2) with the help of the Hooke curve present in the following image.



a. b.

Figure 2. Compression test of wood

a. Hooke's curve

b. Compression test

4. Results

Within the two laboratories, the requirements of the SR EN ISO 17025: 2005 standard are correctly implemented according to the RENAR accreditation body.

The main document contained by accredited laboratories for laboratory operation in conformity with SR EN ISO 17025: 2005 is the quality manual containing procedures for any laboratory activity, operational procedures (sampling and handling of test / sampling objects, validation of methods and assessment of measurement uncertainty, etc.), management procedures (document control, non-compliant product, etc.) and technical procedures (determination of food ores, determination of food pesticides, etc.).

The results of the latest test in the food safety lab are aimed at treating bone cancer with a substance called curcumin.

The results of the ICECON laboratory are for obtaining the maximum limits of compression on wood for constructions.

The results of two accredited laboratories must be clear, concise and validated by the staff of the institution.

5. Conclusions

In order to carry out the work, the next steps have been taken:

- creating a checklist according to the standard SR EN ISO 17025: 2005 analyzing all sections;

- submission of applications to various institutions for a positive response in an accredited laboratory;

- waiting for approval from the institutions for the realization of the scientific work;

- two institutions were receptive to the analysis;

-the first accredited laboratory in which the analyzes were made about the conditions of standard SR EN ISO 17025: 2005 is the "Food Safety Laboratory" within the Polytechnic University of Bucharest after the same standard has been applied in the "Test of resistance to repeated compressive loads" within the Institute research for construction mechanization equipment and technologies;

- the questions from the checklist made in line with SR EN ISO 17025: 2005 were pertinent so the answers of the staff from the accredited laboratories were clear and concise;

Within the RENAR accredited laboratories where the scientific work was performed, a series of activities took place, as:

- visualisation of test reports;

- observing different procedures, from “Complaints handling” to “Metrological equipment and traceability”;

- making a comparison between the food safety laboratory within the Polytechnic University of Bucharest and the laboratory for testing the resistance to repeated compressive loads within the Research Institutes for Equipment and Technologies in constructions;

- studying the implementation and performance of the SR EN ISO 17025: 2005 standard through the checklist made;

- learning how to perform a procedure for an operation;

- understanding how the quality management is implemented in an accredited laboratory and the steps taken to accredit a laboratory;

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VOLUNTEERING IN CRISIS SITUATIONS. CASE STUDY IN TERMS OF HEALTH AND SAFETY AT WORK

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SUMMARY: In this paper, I will detail a personal experience that occurred in a unique crisis situation caused by a war and a pandemic. This situation led to the physical, mental and emotional overload of the involved volunteers. Thus, between Dragobete and Women's Day, two events of major importance overlapped, and at the Ukrainian borders with Romania, people were fighting for survival in their escape from the war. In our case, presented below, we are talking about a multinational company with headquarters in New York and Bucharest, as well as in Moscow, Kyiv and Odessa. The moment the war broke out, our organization decided to help all employees who wished so to relocate from Russia and Ukraine. The purpose of this paper is to address the need to measure the level of accumulated stress, in order to avoid suffering at work. The problem of psychosocial risks at work is an important topic that generates costs that are not negligible for society and must be approached with all the necessary lucidity.

CUVINTE CHEIE: voluntary, criza, stress, SSM

1. Introducere

La finalul lunii februarie 2022 o echipa de douazeci de persoane din cadrul companiei Servicii IT SRL, cu sedii atat in New York si Bucuresti cat si in Moscova, Kiev si Odesa, s-au implicat in activitati de voluntariat in vederea relocarii angajatilor din Rusia si Ucraina, ca urmare a conflictului Ruso-Ucrainean. Subaprecierea volumului de munca estimat a dus la suprasolicitarea persoanelor implicate si implicit la disfunctii ale organizarii muncii, care netratate sau prost tratate, au incidente asupra sanatatii salariatilor. Prelucrarea acestei probleme contribuie la definirea modalitatilor pentru o stare mai buna la locul de munca, profitabile ambelor parti implicate in organizarea muncii. Instrumentul ELVIE ca si metoda de diagnostic si prevenire a riscurilor psihosociale in munca, permite evidentierea locului unde se afla zonele de disfunctie pentru imbunatatirea practicii manageriale.

2. Stadiul actual

In Martinica, in anul 2006, patru intreprinderi solicitau asistenta ARACT Martinica in cautarea unei solutii privind aceasta problema a riscurilor psihosociale, pe care o traversau cu multa culpabilitate si jena. Din ce in ce mai mult, sondajele si studiile pun in evidenta ca un numar crescand de salariati se declara stresati de munca lor, in suferinta, hartuiti…Confruntate cu aceste situatii de “stare de rau la locul de munca” companiile, le considera cel mai adesea ca fiind subiective si nu gasesc instrumente pentru a le face fata. Creand instrumentul ELVIE, ARACT Martinica permite determinarea locului si conditiilor de munca in geneza tulburarilor psihosociale, plecand de la trairea subieciva a individului.

Tulburarile psihosociale apar atunci cand exista un dezechilibru in sistemul alcatuit din om si mediul sau de munca. Notiunea de risc trebuie inteleasa ca probabilitatea aparitiei unei tulburari psihosociale generate de mediul profesional. Aceasta se poate manifesta atat la nivelul persoanei cat si in anturajul acesteia sub forme variate si inselatoare. Analiza fenomenelor de stres personal sau profesional asupra performantei si sanatatii arata ca exista o influenta reciproca a planului personal in cel profesional si invers. Totusi aceasta granita, oricat de ingusta ar fi, trebuie sa ramana bine marcata fiind protectoare

atat pentru integritatea si sanatatea salariatului cat si pentru intreprindere, care nu este responsabila de toate tensiunile sociale. Daca proiectele companiei si cele ale angajatului diverg atunci apar dezechilibre si tensiuni care gresit gestionate vor genera riscuri psihosociale.

S-a folosit ca instrument de diagnosticare metoda Elvie care este constituit din trei parti complementare.

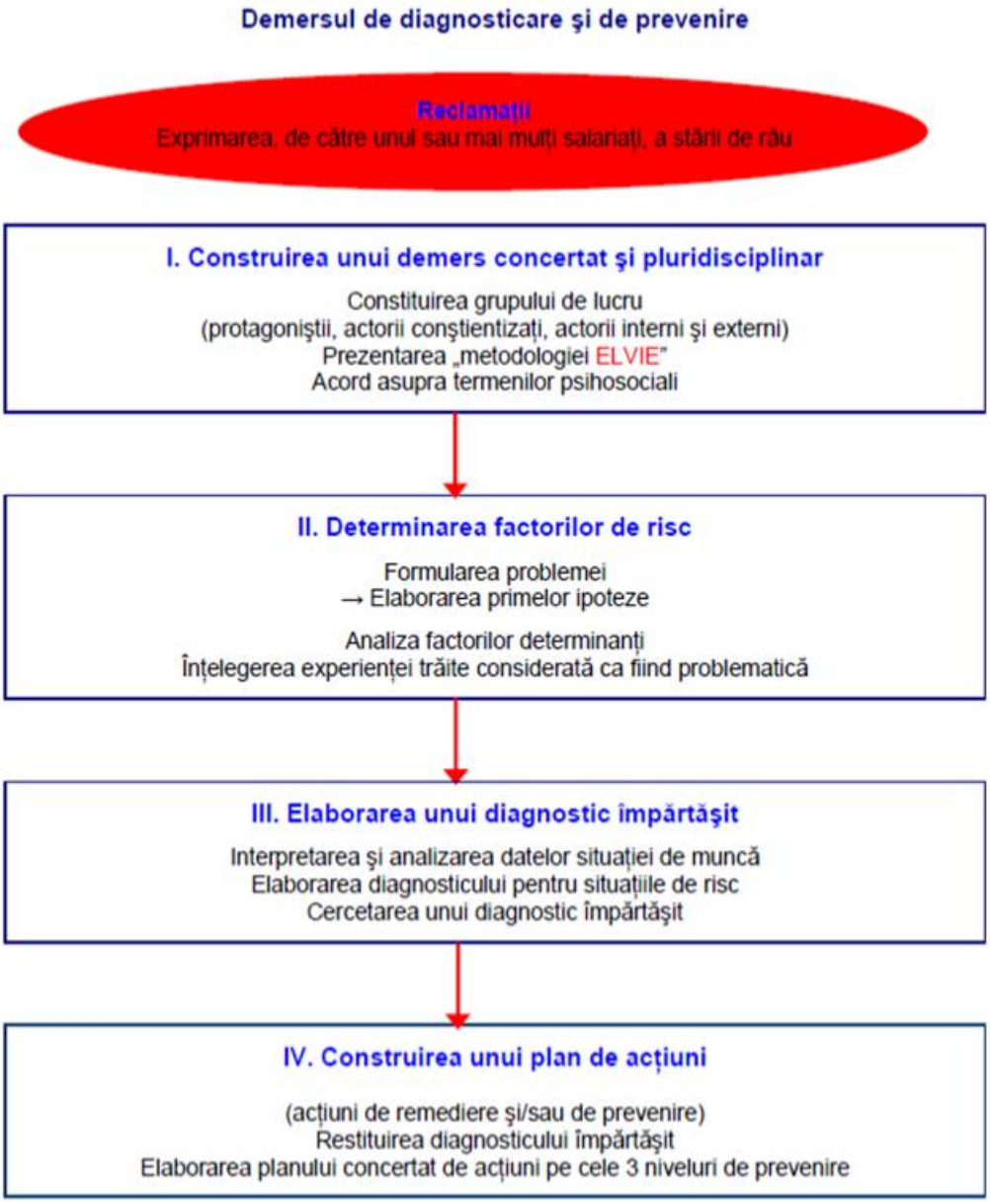

Fig. 1. Demersul de diagnosticare si prevenire a riscurilor psihosociale

3. Etapa 1 Exprimarea problemei

In cazul nostru exprimarea problemei este marcata de plangerile formulate de oamenii implicati in proces: volumul de munca mare in comparatie cu numarul de voluntari, sosirea haotica a refugiatilor din vama, problemele intampinate in gasirea locurilor de cazare sau cu transportul refugiatilor.

Principalele orase din care proveneau oamenii cu care s-a interactionat au fost Kiev si Odessa. La granite se aflau femei si copii cu bagaje si animale, fara barbati (decat foarte rar batrani peste 60 ani), care nu stiau limba romana sau engleza, care nu stiau unde merg si cum se vor descurca, ci doar ca nu se pot intoarce. Era frig si erau multi. Copiii plangeau zgribuliti si obositi in bratele femeilor aflate in aceeasi stare. Se bucurau la fiecare ceai fierbinte pe care il puteau primi de la Asociatiile umanitare aflate in zona pt ajutor. Dupa ore intregi pe drum prin frig, nu intotdeauna fara evenimente (trenuri amanate, intarziate, explozii mult prea aproape decat si-ar dori oricine), mai petreceau niste ore in vama, (loc in care nu aveai cum sa ajungi la ei sa ii ajuti in nici un fel) si abia apoi ajunsi in Romania puteau beneficia de cazare si transport, puse la dispozitie de echipele de voluntariat aflate la fata locului.

4. Etapa 2 Analiza factorilor determinanti ai problemei

In cazul nostru exprimarea problemei este marcata de plangerile formulate de oamenii implicati in proces: volumul de munca mare in comparatie cu numarul de voluntari, sosirea haotica a refugiatilor din vama, problemele intampinate in gasirea locurilor de cazare sau cu transportul refugiatilor.

Analiza factorilor determinanti ai problemei, adica partea a doua a metodei de diagnosticare, demonstreaza ca acestia sunt de natura externa si ei nu pot fi controlati deci imbunatatiti pentru rezolvarea problemei.

Numarul de refugiati care determina volumul de munca, fluctua in functie de inscrierile pe platforma de relocare, Ceea ce facea imposibila cuantificarea lor in vederea asigurarii unui numar de voluntari direct proportional cu inscrierile.

Orele petrecute in vama variau in functie de bagaje, numar de persoane per familie, disponibilitate de personal vamal, amanunte ce nu puteau fi structurate intr-o maniera controlabila.

Deasemenea problemele intampinate cu cazarea si transportul, avand in vedere numarul foarte mare de refugiati intrati in tara in aceeasi perioada cu angajatii relocati, nu se puteau rezolva, dar au fost preluate de catre agentii specializate care au redus in felul acesta o parte din volumul de munca in aceasta directie.

In clipa in care s-a declansat razboiul, organizatia sus numita a hotarat sa relocheze toti angajatii din Rusia si Ucraina, care isi doresc asta. S-a creat o platforma pe care ei se inregistrau, apoi erau contactati si ajutati sa ajunga in orasele in care doreau. Unii sa ramana, altii in tranzit. Si au fost multi. Sunt peste 2000 de angajati ai companiei doar in Bucuresti. Din cele trei orase foarte multi au dorit sa plece. Initial echipa de voluntari din Bucuresti era alcatuita din 20 de oameni care si au luat concediu de odihna ca sa poata face asta. Li s a pus la dispozitie o sala de conferinte dotata cu calculatoare, internet, telefoane si au fost instruiti colectiv SSM/SU ca si vizitatori pentru perioada de voluntariat in noile circumstante.

Modul efectiv de lucru al echipei de voluntari a inceput odata cu inscrierea pe platforma a primelor cereri de relocare. In clipa in care un angajat din Moscova, Kiev sau Odessa trimitea un mesaj din platforma, se crea automat un e-mail catre o adresa la care aveau acces doar cei 20 de voluntari. Fiecare din aceste e-mail-uri creau la randul lor cate un ticket in platforma interna de Service Desk si fiecare raspuns la e-mail-ul respectiv devenea un comment in ticket. Cei 20 de voluntari erau impartiti in echipe care se ocupau de preluarea initiala, rezervarea de transport catre orasul dorit, rezervarea de camere in functie de necesitati (erau familii cu cate 4-5 pers, mama, bunica, copii, animale de companie). Cum angajatii companiei sunt in majoritate barbati, persoanele relocate erau de fapt familiile lor alcatuite din femei traumatizate si obosite care aveau in grija copii, batrani si animale, care nu cunosteau tara, sistemul, compania, limba (de cele mai multe ori nici limba engleza). Deasemenea voluntarii se ocupau si de transportul efectiv in cazul celor care veneau pe la Vama Isaccea.

5. Etapa 3 Intelegerea experientei de viata a actorilor implicate in problema

In etapa a treia, “Intelegerea experientei de viata a actorilor implicati in problema”, se puncteaza dimensiunea psihologica a muncii depuse. In munca nu sunt mobilizate doar resursele fizice si cognitive;

actiunea angajaza intreaga fiinta umana, cu experienta sa, cu emotiile sale, precum si cu felul sau propriu de a privi relatiile.

Per total erau 2-3 voluntari care se ocupau de fiecare task in parte si care trebuiau sa fie in permanenta la curent cu tot ce se intampla cu fiecare familie. De cand erau preluati, se urmareau toate comentariile din ticket, fiecare rezolva partea lui si ultimul care avea informatia ca au ajuns cu bine si s-au cazat, inchidea ticketul ca fiind rezolvat. Adica pt fiecare familie in parte, zeci de mesaje de urmarit in e-mail-uri, in tickete, pe teams intre voluntari, pe telegram cu refugiatii, si pe alte e-mail-uri cu firmele imobiliare si de transport. Si au fost sute de familii relocate. Deci mii de mesaje urmarite 24/7.

Implicarea emotionala in randul voluntarilor a fost maxima, impactul fiind simtit in plin in clipa in care auzeai la telefon o voce tremuranda, un copil plangand langa, sau cand nu mai stiai nimic de un grup care nu a mai iesit din vama de cateva ore sau unul care a pierdut trenul in Ucraina din cauza unei bombe explodate. Asta a facut ca nimeni sa nu se opreasca si sa raspunda la e-mail-uri si telefoane la orice ora din zi si din noapte, indiferent unde se afla. Era un numar prea mic de oameni pentru a lucra in schimburi, refugiatii intrau in tara indiferent de ora (pe care oricum nu o stiai, fiind in functie de cat ii tinea in vama) si nimeni nu avea inima sa ii lase sa astepte in frig pana dimineata.

O administrare discontinua a instrumentului de diagnosticare aplicat de analistul care conduce interviurile, presupune o discutie libera, in care persoana intervievata este lasata sa vorbeasca iar analistul intervine doar pentru a obtine semnificatia reala a evenimentelor descrise si pentru a intelege problema aflata in discutie. Dar nu este vorba despre o procesare statistica a datelor. Informatiile transcrise in ELVIE, permit ordonarea gandirii, in functie de importanta si de pertinenta informatiilor primite. Si prezentarea informatiilor depinde deasemenea de importanta si de pertinenta informatiilor primite. Acestea faciliteaza intelegerea problemei si astfel formularea unui diagnostic calitativ.

Am demonstrat prin metoda ELVIE, tensiunile gresit gestionate in cadrul actiunii de voluntariat, faptul ca frustrarile acumulate inconstient, pot depasi nivelul de stres acceptat pentru continuarea activitatii, faptul ca nesesizarea la timp a disfunctiilor organizatorice, poate duce la suferinta fizica, psihica si emotionala. Prezentand o parte din metoda in aceasta lucrare, se evidentiaza utilitatea unui instrument care face trecerea de la cauzele subiective ale implicarii emotionale la nivelul muncii, la solutiile de ordin obiectiv necesare evitarii riscurilor psihosociale.

6. Rezultate experimentale

Expunerea situatiei problema (vezi tab1; tab.2 si tab.3).

Tabelul 1. Actorii interesati de situatia-problema

Actori	Numar/Functie
Voluntari	20/Administratori
Conducere	1/Director General
Inspector de munca	1/Sef Serviciu Intern SSM

Tabelul 2. Prima caracterizare a problemei de catre actori

	Voluntari	Conducere	Inspector de munca
Volum munca>nr lucratori	Epuizare	Raman cereri nerezolvate	Lucratori irascibili
Dezorganizare refugiati	Imposibilitatea de a ajuta	Imposibilitatea de a org forma de ajutor	Lucratori frustrati
Fara cazare	Inutilitatea efortului depus	Inutilitatea initiativei	Lucratori dezamagiti
Fara transport			

Tabelul 3. Expunerea situatiei-problema

	Ce s-a intamplat?	Context	Factor declansator	Natura problemei	Frecventa	Altceva
Voluntar	Epuizare	Suprasolicitare	Relocare sal.	Organizatorica	Des	
Conducere	Cereri nerez.	Relocare sal.	Razboi	Organizatorica	Exceptionala	
Insp. munca	Atm. Tens.	Adapt.dificila	Situatie noua	Organizatorica	Rar	

Analiza situatiei problema cuprinde identitatea profesionala (vezi tab.4, tab.5 si tab6) iar colectarea informatiilor (vezi tab.7 si tab.8).

Tabelul 4. Voluntar

Sex	Varsta	Functie	Loc de munca	Statut in companie	Vechime in functie	Vechime in companie
F	46	Receptionista	SC Servicii IT SRL	Angajat	20 ani	7 ani

Tabel ul 5. Conducere

Sex	Varsta	Functie	Loc de munca	Statut in companie	Vechime in functie	Vechime in companie
M	46	Director General	SC Servicii SRL	Conducere	10 ani	25 ani

Tabelul6. Inspector de munca

Sex	Varsta	Functie	Loc de munca	Statut in companie	Vechime in functie	Vechime in munca
M	37	Sef Serv Intern SSM	SC Servicii SRL	Angajat	10 ani	15 ani

Colectarea informatiilor (vezi tab.7 si tab.8) se face tinind cont de cele sase variante posibile: A-nu sunt deloc de accord; B-sunt partial de accord; C-sunt de accord; D-sunt total de accord; E-nu ma intereseaza; F-nu stiu

Tabelul 7. Cplec tarea informatiilor de la 1 la 5

	A	B	C	D	E	F
1. Aprecierea muncii depuse						
1. Rezultatele muncii mele sunt apreciate de conducere				X		
2. Evolutiile inregistrate in munca ma ajuta sa progresez			X			
3. Rezultatele muncii mele sunt recunoscute de colegii mei					X	
4. Organizarea ierarhica raspunde intotdeauna cerintelor	X					
5. Primesc incurajari care ma ajuta sa desfasor o munca de calitate						X
6. Nu am decat rezultate negative legate de munca mea	X					
2. Relatii de munca/Sprijin social						
7. Relatiile mele cu colegii sunt agreabile			X			
8. In situatii dificile sunt sustinut de colegii mei			X			
9. Conducerea are rol de arbitru in caz de litigiu in cadrul echipei	X					
10. La locul de munca nu sunt nedreptatit	X					
3. Limite de actiune/Autonomie la locul de munca						
11. Am posibilitatea sa imi stabilesc ritmul de munca	X					
12. Nu sunt supus presiunii	X					
13. Conducerea este flexibila	X					
14. Relatiile de autoritate nu sunt apasatoare	X					
4. Dispozitii						
15. Primesc instructiuni clare		X				
16. Nu primesc ordine contradictorii	X					
17. Instructiunile si procedurile imi usureaza munca			X			
18. Conducerea imi inlesneste indeplinirea sarcinii		X				
5. Sensul muncii						
19. Munca mea este utila				X		
20. Imi place sa vorbesc despre activitatea mea in societate			X			
21. Atributiile mele se regasesc printre obiectivele intreprinderii		X				
22. Consider ca exista o stare de bine la locul meu de munca		X				

Tabelul 8. Colectarea informatiilor de la 6 la 15

	A	B	C	D	E	F
6. Perspective						
23. Compania in care lucrez imi ofera evolutii interesante ale carierei	X					
24. Imi doresc sa progresez si sa-mi asum noi responsabilitati				X		
25. Exista o politica de evaluare a competentelor	X					
7. Sarcina de munca						
26. Nu sunt confruntat cu agresivitatea publicului	X					
27. Agreez responsabilitatile pe care le am		X				
28. Daca nu am terminat o lucrare altcineva ma poate inlocui	X					
8. Igiena, securitate, conditii materiale						
29. Mediul de munca este corespunzator				X		
30. Spatiile sunt adaptate muncii				X		
31. Dispun de mijloace suficiente pentru a desfasura o munca de calitate				X		
9. Contributie, retributie						
32. Consider ca sistemul de acordare a primelor este stimulativ				X		
33. Sistemul de remunerare este motivant		X				
34. Exista un echilibru intre contributia si retriibutia mea		X				
35. Eforturile mele imi confera respectful si stima binemeritate			X			
10. Interes, diversitatea muncii						
36. Munca mea este interesanta			X			
37. Pot sa fiu creativ in activitatea mea	X					
38. Munca mea este suficient de variata		X				
39. In activitatea mea am posibilitatea sa invat lucruri noi		X				
11. Incredere, cooperare						
40. Nu imi este teama sa iau initiative	X					
41. Stiu pentru ce cui si cand trebuie sa raspund		X				
42. Daca fac o gresala sunt aspru sanctionat	X					
43. Am incredere in munca celorlalti	X					
12. Fractionarea muncii						
44. Nu ma deranjaza sa fiu interupt si deranjat frecvent in timpul muncii	X					
45. Pot sa-mi termin munca fara sa fiu intrerupt	X					
46. Nu ma deranjaza sa fac 36 de lucruri in acelas timp		X				
47. Pot sa primesc taskuri noi chiar daca nu le-am terminat pe celelalte		X				
13. Polivalenta						
48. Sunt suficient de bine pregatit pentru polivalenta de la locul de munca				X		
49. Nu am sentimntul ca servesc de inlocuitor				X		
50. Polivalenta imi permite sa progresez			X			
14. Comunicare, informare						
51. Particip cu regularitate la sedintele de birou				X		
52. Sedintele de lucru sunt utile			X			
53. Am toate mijloacele de informare de care am nevoie			X			
54. Primesc informatiile la timp pentru a-mi realiza sarcinile de lucru	X					
55. Informatia circula bine in departamentul meu		X				
15. Competenta corespunzatoare muncii						
56. Ma adaptez usor la schimbarile privind sarcina de munca din departament			X			
57. Nu intampin dificultati atunci cand relationez cu publicul			X			
58. Ceea ce mi se cere sa fac corespunde calificarii mele				X		
59. Am capacitatea sa ma adaptez evolutiilor din cadrul companiei			X			
60. Pozitia mea profesionala actuala corespunde pregatirii mele			X			
61. Politica de evaluare a competentelor este utila			X			

Raspunsurile sunt contabilizate pe fiecare tema. In sine, fiecare raspuns permite determinarea surselor de tensiuni ale situatiei-problema, conform grilei: O majoritate de A si/sau B caracterizeaza tensiunile prost gestionate; O majoritate de C si/sau D caracterizeaza tensiunile controlate

Rezultatele pot fi reprezentate grafic prin atribuirea de culori fiecarui raspuns, ceea ce permite o identificare vizuala a surselor de tensiuni: A si B si C si D.

Tabelul 9. Tema. Limite de actiune/Autonomie la locul de munca

Propozitii	A si B %	C si D%	E si F%	Tendinta
P11	100	0	0	
P12	100	0	0	
P13	100	0	0	
P14	100	0	0	

Tendintele sunt definite in functie de raportul dintre procentajele raspunsurilor.

Tabel 10. Tema: Limite de actiune/Autonomie la locul de munca

Propozitii	Tendinta
P11	
P12	
P13	
P14	

Propozitiile sunt clasificate in functie de tendinta.

Tabel 11. Limite de actiune/Autonomie la locul de munca

Tensiuni controlate	Probabilitate de rasturnare a situatiei	Tensiuni prost gestionate
0	0	Ritmul de munca Presiune Conducere inflexibila Autoritate apasatoare

Tensiunile sunt clasificate in functie de gradul de control.

7. Concluzii

Instrumentele folosite au generat o abordare pragmatica a problemei cu solutii obiective, aplicate concret exact acolo unde erau carente.

Dupa aproximativ cinci zile, cu flux constant de lucru, cand echipa de voluntari deja prezenta simptome fizice de epuizare (ameteli, stari de greata, vertij), cu ajutorul departamentului HR care a promovat actiunea, am reusit sa suplimentam echipa cu pana la 40 de voluntari activi si inca 20 in stand by, pregatiti sa plece pe teren pentru transport sau sa ii preia in cazare aproape de granite sau vorbitori de limba rusa.

De cele mai multe ori nu stim cand sa ne oprim si consideram sacrificiul de sine ca fiind indiscutabil necesar pentru ajutorarea celorlalti. Daca avem nevoie de instrumente care sa ne demonstreze propriile limite, atunci trebuie sa le folosim, cu atat mai mult cu cat ele exista. De fapt siguranta salvatorului este indiscutabila. Fara ea nu avem salvator deloc sau avem doua victime. Prima lege in acordarea ajutorului de orice fel, este ca cel care ajuta sa nu ajunga el insusi in pozitia de victima.

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DESIGN AND MAINTENANCE PROCESS MANAGEMENT

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This study aims to highlight the design and maintenance issues found in cars.
The methodology used to conduct this study involved the collection of relevant data and information through a process of documentary research to identify design issues.
The identified issues were presented in a structured way, separated into general implementation issues and specific issues, as well as into subcategories depending on the internal or external factors to which they relate.
Based on this survey, an analysis was made of consumers' perceptions of vehicle life and the most common failures.

KEY WORDS: design, maintenance, marketing

1. Introduction

This study aims to highlight the design and maintenance issues found in cars. The objectives of this study are design and maintenance, marketing and its influence on production lines, maintenance vs. perception of car owners (survey), highlighting the main design and maintenance issues and conclusions drawn in this case.

2. Status

To begin with, design, as Richard Feilden puts it, involves the use of scientific principles, technical information, and imagination to define mechanical structures, machines, and systems with pre-specified functions, with maximum economy and efficiency (Richard Feilden 1963 - engineer and architect).

As can be seen, Figure 1.1 shows the systematic representation of the design:

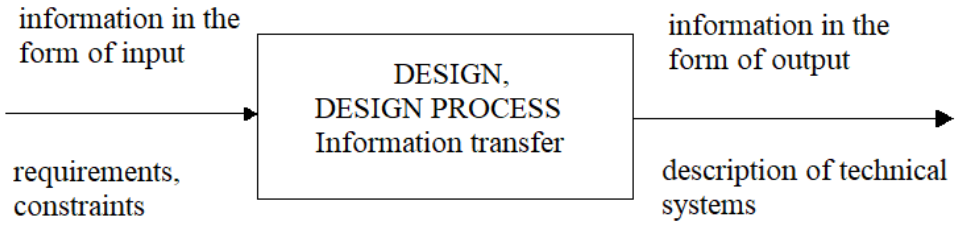

Fig.1.1 Systemic representation of the design

The purpose of the design (Mostow, 1985) is built on a structure of the form:

• Satisfaction of given functional specifications;

• Complies with environmental limitations;

• Implies implicitly or explicitly performance requirements - time, space, power, cost, etc. - and structure - style, clarity, etc.

• Satisfaction of restrictions imposed by the design process itself

As we all know, any product needs maintenance. But what does this term mean? Well, "maintenance" involves the choice of means of prevention, correction or renovation in order to monitor the wear of the equipment in order to reduce costs, in which case it can be considered that maintenance means "supervision" of the machine.

Despite the fact that we bring out engineers in the industrial field, the quality branch, the longevity of today's cars is strongly affected by marketing. In other words, the target of the manufacturers is no longer the reliability of the cars but rather the profit, which in a considerable percentage is obtained from the sale of car parts.

Consumer society encourages us to consume as much as possible, and to consume as much as possible, it automatically decreases the quality of products. Thus, the expected lifespan for the respective product has decreased, the technology, manufacturing and maintenance being modified so as to satisfy the consumer's requirements. From the manufacturer's point of view, the life cycle of a product can be approached in two aspects: one that refers to the actual production, and the other that refers to the marketing activity.

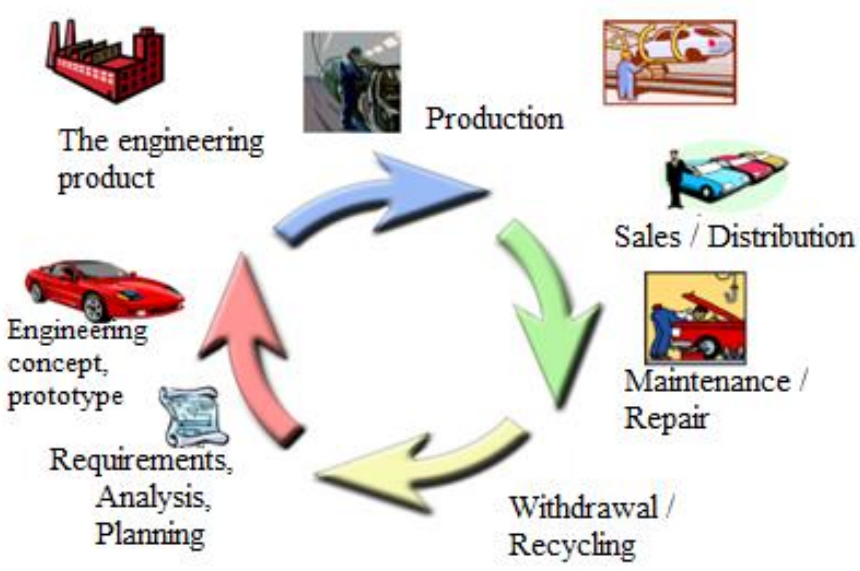

Fig.1.2 Management of the Lifespan of a Product

For the customer, the life cycle of a product has three main stages:

• product purchase

• its operation / use and execution of maintenance / upkeep operations (if applicable);

• disposal and / or replacement of the product when required or when the beneficiary so wishes for various reasons.

Taking into account all these aspects, a survey was conducted in which data were collected both about the owner and the technical data of the owned car, the purpose being to identify the technical problems they encountered after a certain number of km traveled since the purchase of the car. , as well as an image of a so-called "ideal" car and the expectations they have from it.

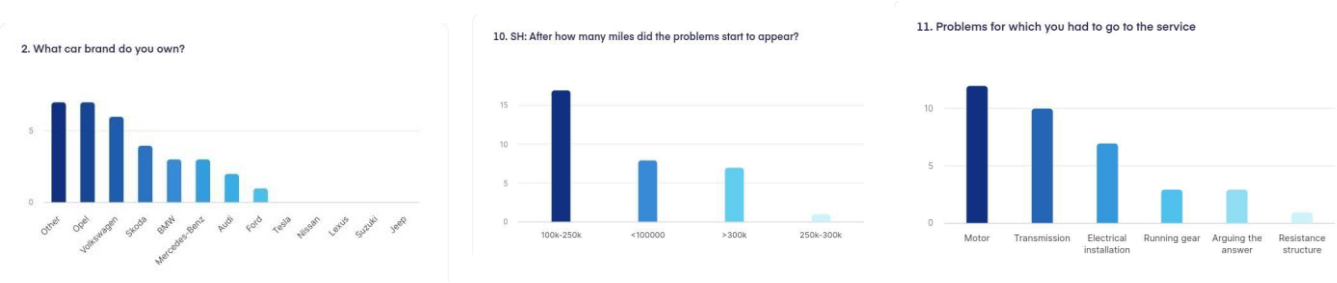

Fig 1.3 statistical results

Following the collection and filtering of the obtained data, it was found that in a percentage of approximately 33% people arrived with the cars in service due to the problems of the engine assembly of the owned vehicle, 29% of them encountered defects of the transmission system, 20% defects of electrical installation, 9% with running gear failures as well as various other problems.

As previously noted, the most common problems with a car getting into service are engine problems.

Inside the high-pressure pump on the diesel engines of the well-known Bavarian car brand known as BMW, the following problem is encountered, which considerably shortens the life of the engine. In the most unfortunate cases, the engine is no longer able to be restarted. This is a cylindrical ball bearing that reduces the friction between the camshaft and the piston of the pump, which unfortunately wears out prematurely and ends up changing its position so that the camshaft ends up grinding it. The first sign of wear of the high pressure pump is a very cumbersome hot start (after much insistence) but also very difficult to detect. In such a situation, after the diagnosis it is found as an error "low starting pressure". Low starting pressure may be due to:

- malfunction of crankshaft speed sensor that controls diesel power supply as a function of speed

-pronounced wear of the pressure regulator on the pump (solenoid valve that closes / opens the return circuit) no longer tight

- pronounced wear of the pressure regulator on the ramp; When trying to start the engine, this regulator must remain in the closed position for 3 revolutions of the crankshaft or more depending on the wear until the pressure before it reaches about 300 bar to be possible to start the engine. Due to the wear, the effort made by the solenoid valve is greater, its opening being made more and more difficult and in some cases not being possible anymore.All the problems listed above are identified with the same error code that identifies the wear and tear of the high pressure pump.

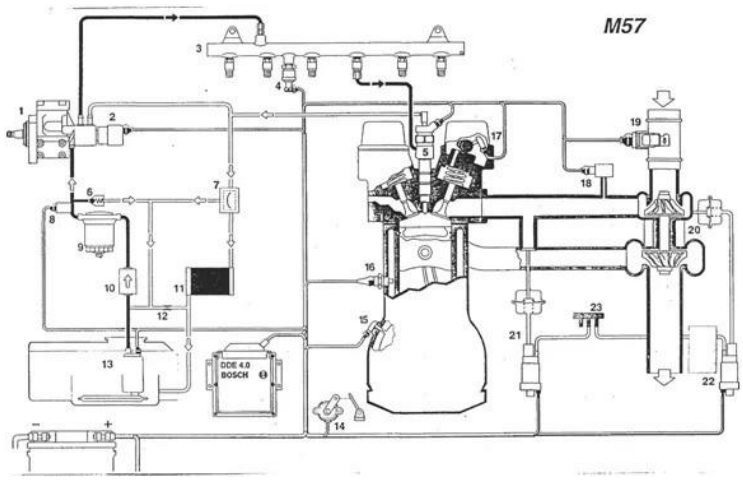

Fig.1.4 Scheme of principle

As mentioned above, after the pump has worn out, the resulting span ends up being transported to the injectors by fuel by plugging their holes or locking them in the open position which leads to melting or breaking the pistons, breaking the connecting rods, breaking the engine block, bending the valves and / or breaking hydraulic plugs. This problem arose from the tightening of pollution rules which forced the manufacturer to increase the fuel pressure in the injection ramp in order to reduce the degree of pollution and again we reach marketing where the manufacturer no longer invested in research to redesign the whole pump work which leads to premature wear and automatically decreases the significant life of the engine.

3. Conclusion

In conclusion, with the help of the survey, an image of an "ideal" car was made according to the requirements and desires of consumers and their vision of it. Thus, the car must include qualities such as reliability, safety, performance, premium quality with a low budget, minimum maintenance costs, minimum operating costs and comfort.

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Self-assessment of the performance of a company in the automotive industry based on the EFQM excellence model

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Summary: In this document are presented the strengths and areas of improvement occurred from the self-assessment based on the EFQM excellence model of the performance of the Renault Technologie Roumanie company, an organization operating in the field of the automotive industry. This company is actually a regional center that deals with engineering activities and technical consulting (CAEN 7112) for the Renault Group. Following this self-assessment, an overview of this company is created and an action plan for areas for improvement will be implemented.

Introduction

In this scientific document the company Renault Technologie Roumanie will be analyzed according to EFQM excellence model.

Renault Technologie Roumanie (RTR) is a regional engineering center of the Renault Group. The main responsibility of this company, is the global development of the Dacia range but also a small part of the Renault range, especially an adaptation of projects targeting vehicles and mechanical manufacturing in the Eastern Europe and the Mediterranean region [1].

This company have design offices in Bucharest, where engineers try to fulfill market requirements in terms of automobiles. The vehicles designed in those offices are tested and approved on the Titu Technical Center. After an authority give the approval, the vehicles are mass-produced in the Mioveni factory [1].

Current stage

The EFQM's principles of excellence are chosen in order to cover all the concepts of this evaluation, to have a whole picture to this company.

- Achieving Balanced Results [2]
- Taking Responsibility for a Sustainable Future [2]

By covering all the concepts of this model, a much clearer overview of this organization can be achieved at the end of this evaluation. Both the concepts that have a positive impact on the organization and those that can be improved can be determined. These improvements can be implemented through an action plan.

Table. 1. EFQM principles and concepts [3]

	1					2				3					4					5					6		7		9	
	Leadership					Strategy				People					Partnerships & Resources					Processes, Products and					Customer Results		People Results		Key Results	
	A	B	C	D	E	A	B	C	D	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	A	B	A	B
Achieving Balanced Results		■	■			■		■	■							■			■						■	■	■	■	■	■
Taking Responsibility for a Sustainable Future	■	■	■		■			■					■	■			■					■								

Fig. 1. EFQM principles spider chart

Based on the spider chart in the Fig 1 and on the principles and concepts from table 1, in this document will be presented the strengths and areas for improvement for concepts whose points are common and the same concepts taken separately.

The strengths of this company which are identified after going through all the concepts and principles of the EFQM, are on the side of products and services, exactly on point 5C of this assessment scorebook (Products and services are designed and developed based on customer needs and expectations), where this company scored a total of 55 points out of the total of 100 points and on the leadership side, exactly on point 1C (Leaders interact with customers, partners and representatives of society), where this company scored a total of 60 points out of the total of 100 points. On this last point (1C), even if it has the highest score from all the concepts, on the systematic deployment part there where the approach must be deployed in a structured way with the method used for deployment being planned and executed soundly, this company scored 35 points out of the total of 100 points. This systematic deployment is directly linked to the people and their results.

The main problem in this organization, according to the scoring mentioned before, is not that the people don't get good results in general, but they do not get good results compared to the goals that are set by the organization. These things can explain areas for improvement that are identified after going through all the concepts of the EFQM. Those points are on the people side, exactly on the point 3D (People and the organization have a dialogue) where this company scored 35 points out of the total of 100 points, on the people results (7B Performance Indicators) and key results (9A Key Performance Outcomes) where this company scored 40 points out of the total of 100.

Table. 2. EFQM results [3]

	1					2				3					4					5					6		7		9	
	Leadership					Strategy				People					Partnerships & Resources					Processes, Products and					Customer Results		People Results		Key Results	
	A	B	C	D	E	A	B	C	D	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	A	B	A	B
Achieving Balanced Results						50%			45%							35%			55%						55%	45%	45%	40%	40%	45%
Taking Responsibility for a Sustainable Future	55%	50%	60%		45%			55%					35%	45%			45%					55%								
Total Score	53%					50%				40%					45%					55%					50%		43%		43%	

Strenghts:

1C) Leaders interact with customers, partners and representatives of society

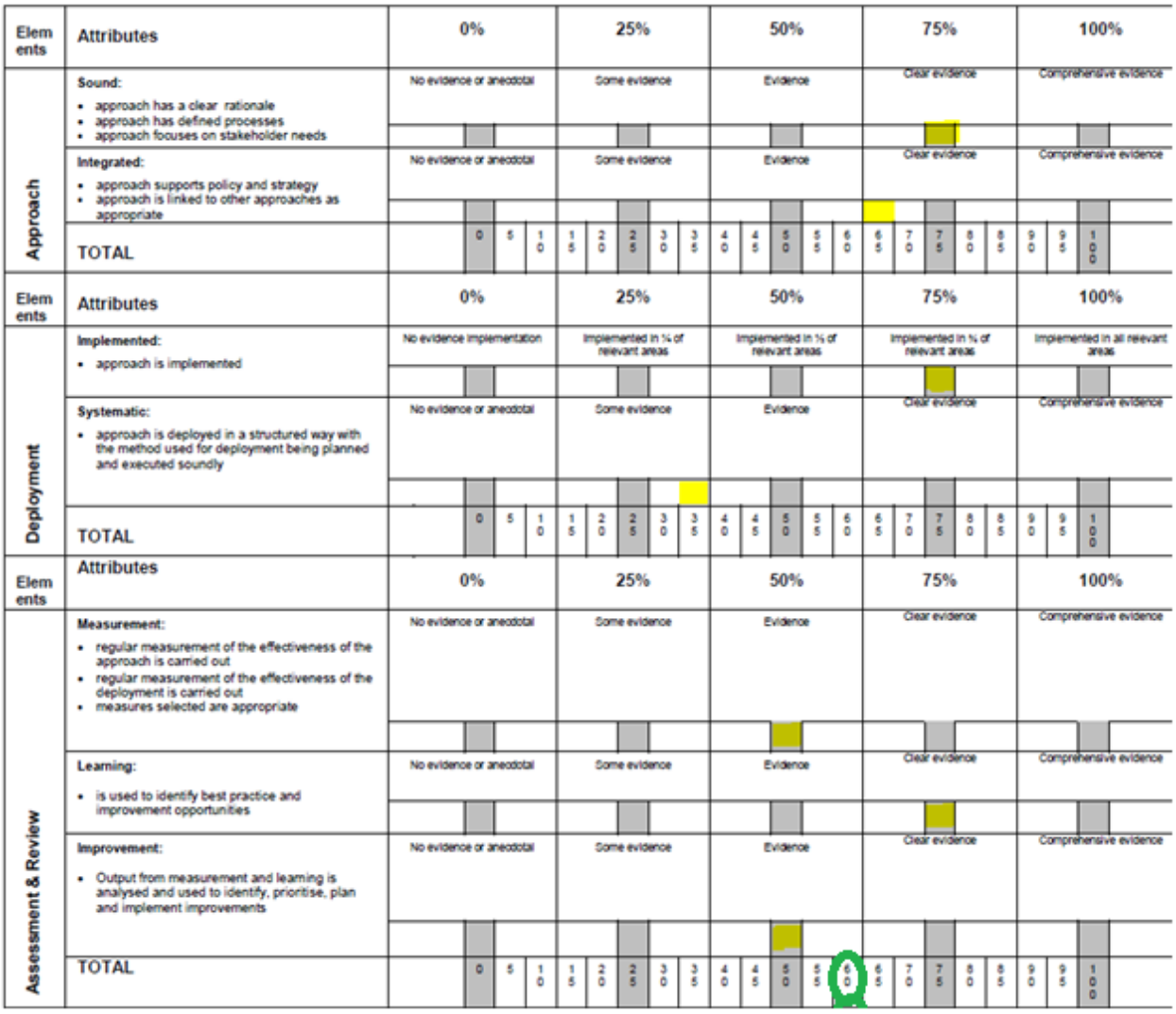

Fig. 2. EFQM 1C Leaders interact with customers [2]

a) Developing, maintaining and participating in partnerships is a strong point of the organization's leadership. This leadership frequently analyze opportunities and develop partnerships.

b) Leaders frequently participate in professional associations, conferences and seminars that promote and support excellence. This process is continuously monitored and improved through concrete graphics and actions.

c) The leaders of this organization also promote and support activities aimed at improving the environment and the organization's contribution to society, from designing projects so that they are close to 100% recyclable, as well as reducing the CO2 footprint and pollutant emissions, of the vehicles.

5C) Products and Services are designed and developed based on customer needs and expectations

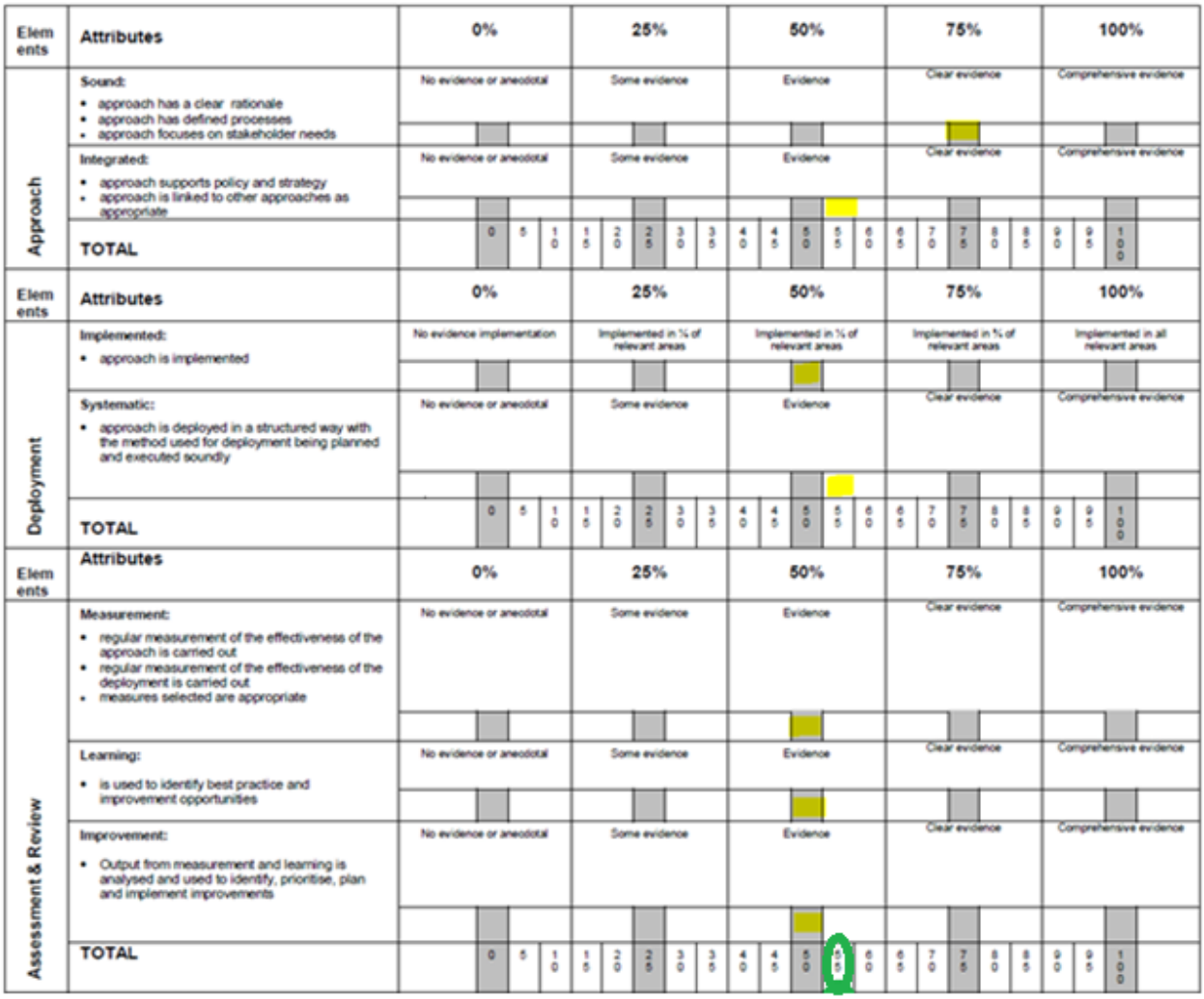

Fig. 3. EFQM 5C Products and Services [2]

a) Customer surveys and market research are often used before launching a product to determine customer needs and their expectations.

b) The products are analyzed through a special department of competition analysis and client feedback. With the help of these departments, improvements of the actual product can be well identified, and the desired results can be anticipated.

c) Products and services for clients and partners are permanently created and developed according to market requirements (ex department of the voice of the client).

Areas for improvement

3D) People and the organization have a dialogue

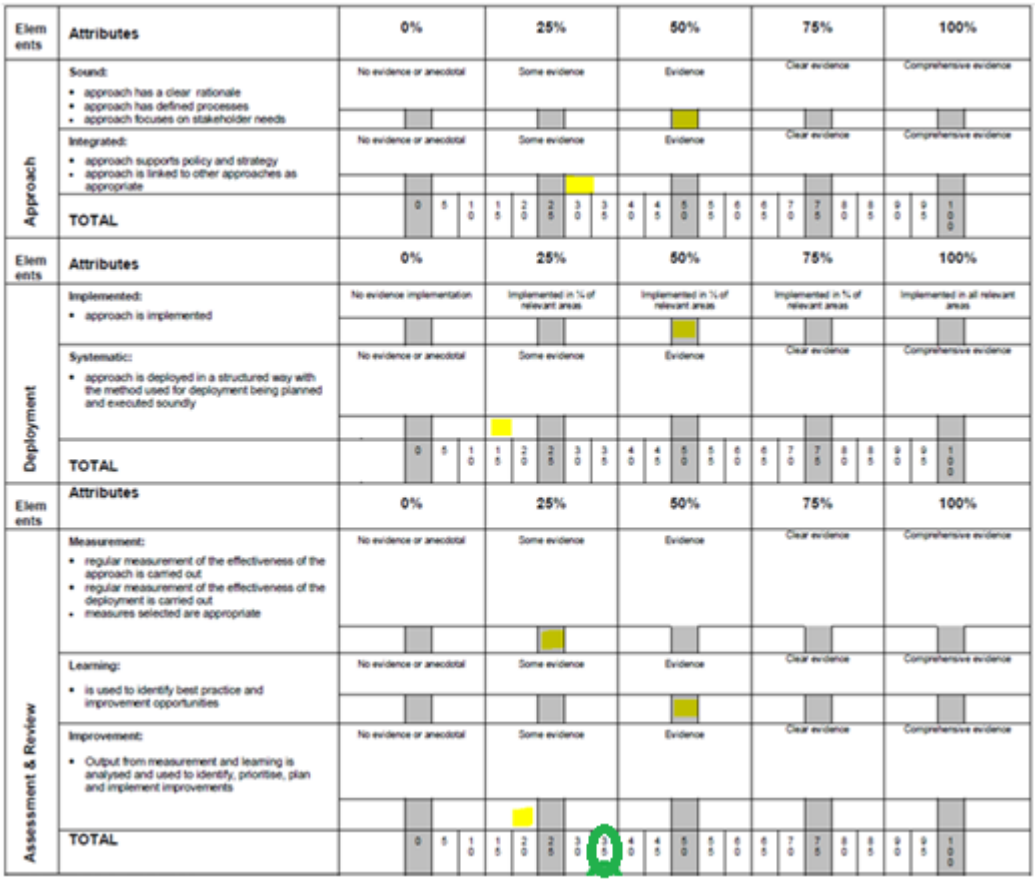

Fig. 4. EFQM 3D People and the organization [2]

a) Strategies and plans based on communication needs, have to be improved at the level of employee representatives and human resources.

b) Opportunities to share good practices and knowledge need to be further developed within this organization.

c) Communication channels are very well developed from top to bottom, but less developed from the bottom up.

7B) Performance Indicators

Elements	Attributes	0%	25%	50%	75%	100%
Results	Trends: • trends are positive AND/OR there is sustained good performance	No Results or anecdotal information	Positive trends and/or satisfactory performance for about ¼ of results over at least 3 years	Positive trends and/or sustained good performance for about ½ of results over at least 3 years	Positive trends and/or sustained good performance for about ¾ of results over at least 3 years	Positive trends and/or sustained good performance for all results over at least 3 years
	Targets: • targets are achieved • targets are appropriate	No Results or anecdotal information	Achieved and appropriate for about ¼ of results	Achieved and appropriate for about ½ of results	Achieved and appropriate for about ¾ of results	Achieved and appropriate for all results
	Comparisons: • results compare well with others AND/OR results compare well with acknowledged 'World Class'	No Results or anecdotal information	Favourable comparisons for about ¼ results	Favourable comparisons for about ½ results	Favourable comparisons for about ¾ results	Favourable comparisons for all results
	Causes: • results are caused by approach	No Results or anecdotal information	Cause and effect visible for about ¼ results	Cause and effect visible for about ½ results	Cause and effect visible for about ¾ results	Cause and effect visible for all results
	TOTAL	0 5 10	15 20 25 30 35	40 45 50 55 60	65 70 75 80 85	90 95 100
Elements	Attributes	0%	25%	50%	75%	100%
	Scope: • results address relevant areas • results are appropriately segmented e.g. by customer, by business	No Results or anecdotal information	Results address ¼ of relevant areas and activities	Results address ½ of relevant areas and activities	Results address ¾ of relevant areas and activities	Results address all of relevant areas and activities
	TOTAL	0 5 10	15 20 25 30 35	40 45 50 55 60	65 70 75 80 85	90 95 100

Fig. 5. EFQM 3D Performance indicators [2]

9A) Key Performance Outcomes

Elements	Attributes	0%	25%	50%	75%	100%
Results	Trends: • trends are positive AND/OR there is sustained good performance	No Results or anecdotal information	Positive trends and/or satisfactory performance for about ¼ of results over at least 3 years	Positive trends and/or sustained good performance for about ½ of results over at least 3 years	Positive trends and/or sustained good performance for about ¾ of results over at least 3 years	Positive trends and/or sustained good performance for all results over at least 3 years
	Targets: • targets are achieved • targets are appropriate	No Results or anecdotal information	Achieved and appropriate for about ¼ of results	Achieved and appropriate for about ½ of results	Achieved and appropriate for about ¾ of results	Achieved and appropriate for all results
	Comparisons: • results compare well with others AND/OR results compare well with acknowledged 'World Class'	No Results or anecdotal information	Favourable comparisons for about ¼ results	Favourable comparisons for about ½ results	Favourable comparisons for about ¾ results	Favourable comparisons for all results
	Causes: • results are caused by approach	No Results or anecdotal information	Cause and effect visible for about ¼ results	Cause and effect visible for about ½ results	Cause and effect visible for about ¾ results	Cause and effect visible for all results
	TOTAL	0 5 10	15 20 25 30 35	40 45 50 55 60	65 70 75 80 85	90 95 100
Elements	Attributes	0%	25%	50%	75%	100%
	Scope: • results address relevant areas • results are appropriately segmented e.g. by customer, by business	No Results or anecdotal information	Results address ¼ of relevant areas and activities	Results address ½ of relevant areas and activities	Results address ¾ of relevant areas and activities	Results address all of relevant areas and activities
	TOTAL	0 5 10	15 20 25 30 35	40 45 50 55 60	65 70 75 80 85	90 95 100

Fig. 6. EFQM 9A Key Performance Outcomes [2]

Those two points 7B) and 9A) are directly linked to each other

a) Although the trainings are very well developed, the objectives are very ambitious and cannot be fully achieved.

b) The organization was affected during the pandemic and by the current context of military conflicts and the market share has decreased.

c) The vision and mission are very ambitious, and the success rate is affected.

d) Many of the departments of this organization exceed the allocated budget.

In this page it is presented a spider chart for the concepts that can be found on the both principles and for each of these principles taken separately in order to make the image of the organization much clearer following this EFQM analysis.

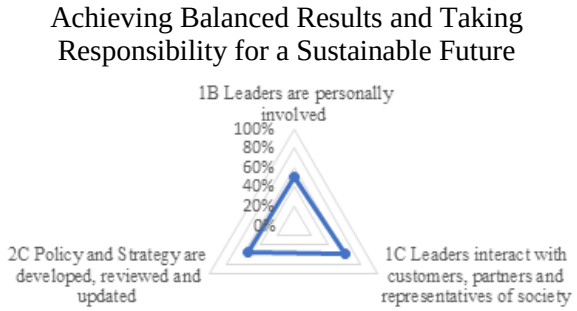

Fig. 7a. Spider chart for both principles

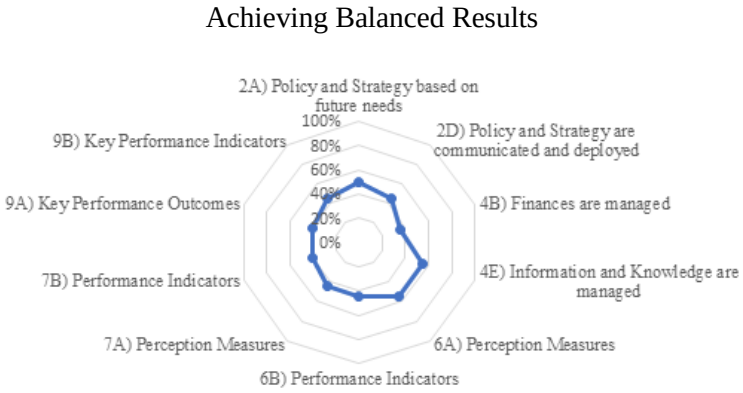

Fig. 7b. Spider chart for Achieving Balanced Results

Fig. 7c. Spider chart for Taking Responsibility for a Sustainable Future

The total score of the EFQM evaluation is presented in the graphic bellow

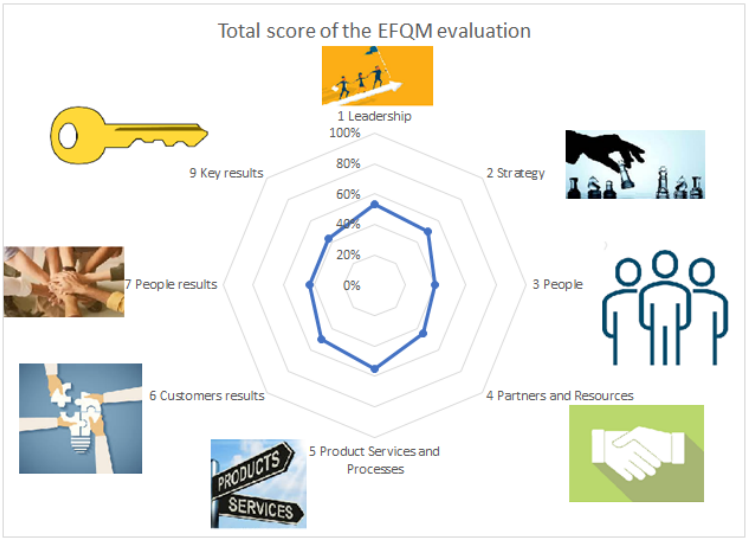

Fig. 8. Total score of the EFQM evaluation [4],[5],[6],[7],[8],[9],[10],[11]

Action Plan

As an action plan, the strategy must be modified by the leaders so that the proposed objectives to be more accessible to people from this organization and in this way, the performance indicators for the people and key results will be higher.

With this approach employees and partners which shows that they are doing their job properly can stand out and take more responsibilities much quicker. Also, the resources can be managed better.

Conclusions

According to the chart above (Fig 8), the organization respects its position on the market. There has to be a balance in order to respect the wishes of the customers and to give products as affordable as possible, without neglecting the price-quality ratio and the reliability of the products.

As in the EFQM score, there is a balance in the organization, because this organization does not want to attack luxury markets or other more dangerous markets. This manufacturer gives products for the global access market.

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MODELING AND SIMULATION OF MECHATRONIC ASSEMBLIES THROUGH TINKERCAD VIRTUAL APPLICATION

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ABSTRACT: The authors set out to model and simulate two mechatronic assemblies using the TINKERCAD virtual application. To make the simulation model of the two mechatronic assemblies, they will choose the optimal components needed for the assemblies, they will assemble virtual ones, they will write the program codes necessary to display the problem of messages on LCD, as well as the observation and analysis of how electronic components interact and respond, at the given orders. The proposed goal of modeling and simulation is to create two widely used mechatronic assemblies, both in the automotive industry and in many other fields.

KEYWORDS: mechatronics, modeling, simulation, TINKERCAD, programming.

1. Introduction

The aim of this paper is to study the possibility of modeling and simulating mechatronic assemblies through the virtual application TINKERCAD.

Performing modeling and simulation involves: establishing the components needed for assembly, assembling them, writing operating codes, as well as observing and analyzing how the components chosen for assembly interact and respond to commands.

The authors set out to firstly make a mechatronic assembly for temperature measurement and displaying it on a 16x2 LCD screen, as well as a visual warning by lighting one of the three LEDs mounted, depending on the temperature range indicated as critical.

The authors also set out to make another mechatronic assembly for measuring distance by displaying it on a 16x2 LCD screen, as well as warning of critical values, both visually by lighting some LEDs and acoustically by emitting sounds by a buzzer.

2. The current stage of development

In order to carry out the two mechatronic assemblies, several electronic components are used, such as: Arduino Uno board, BreadBoard, LEDs, potentiometers, TMP36 temperature sensor, resistors, connection cables, 16x2 LCD screen, power cable, buzzer, ultrasonic sensor [1].

Arduino Uno board, shown in Fig. 1, is an open-source processing platform based on flexible and easy-to-use software and hardware.

At the bottom right of the Arduino Uno board are the analog pins (A0 ... A5), and at the top we find the digital pins (0 ... 13). The grounding (GND) is found in three places on the board, namely: one at the top and two at the bottom. The power supply is of three types: 3.3V, 5V and Vin, where an external battery can be connected (7-12V). Circuit codes are read by ATMEGA 328P PU.

The BreadBoard is required to make circuits or assemblies without soldering the electronic components. The connections between the components placed on the BreadBoard are made through the ends of the metal plate. These metal (main) ends are oriented horizontally at the edges of the BreadBoard for power supply at «-» and «+» and vertically at the rest for the introduction of electrical elements, and in the middle of it there is a horizontal delimitation called the separating area.

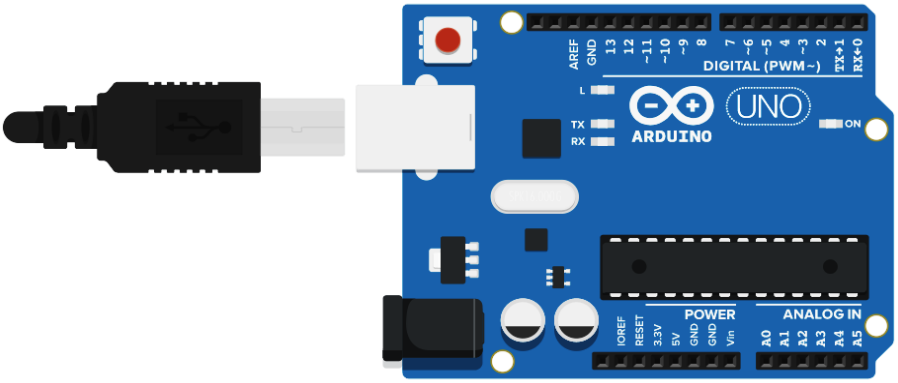

Fig. 1. Arduino Uno Board

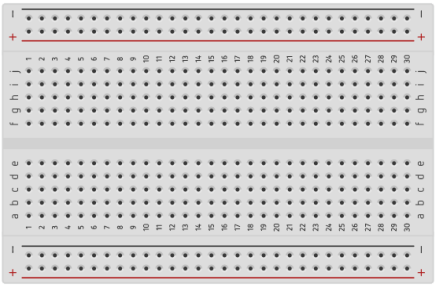

Fig. 2. BreadBoard

Another important component used is the 16x2 LCD screen, shown in fig. 3, which is electronically controlled by a numeric and alphabetic character decoder.

It can display a text of 32 characters, 16 on each of the two available lines. Liquid crystals are substances that have common properties of two states of aggregation, liquid and solid. The molecules that make up this liquid are arranged in the same way as crystals.

These crystals have the property of being able to be controlled by electrical voltage, so they order their molecules from "transparent" to "non-transparent" state.

It is an electrical polarization of liquid molecules that in contrast to the rest of the "field" form a visible image. In other words, the crystals will allow light to pass through them or stop it, causing the pixels to light up in the right colors and compose the image we see on the screen.

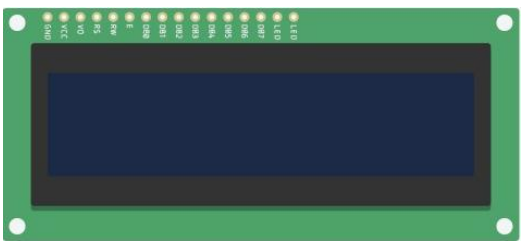

Fig. 3. 16x2 LCD Screen

The potentiometer, illustrated in Fig. 4, is an analog, passive device used to change the value of resistance or voltage in the range of 0-5V in a circuit. The voltages correspond to digital values of a range

0 - 1023, directly proportional to the applied voltage. It has 3 pins: the first is for GND, the second is for the connection to the A0 output and the third is for the value of 5V.

Fig. 4. Potentiometer

The analog temperature sensor, Fig. 5, generates the signal according to the ambient temperature. It provides a voltage at the output that is directly proportional to the temperature in degrees Celsius. It operates with a supply voltage of 2.7… 5.5 V.

Its operating range is from -40 C to + 125 C. The sensor is connected to the Arduino Uno board, as follows: we orient the sensor with the convex side I hope and the left pin is connected to 5V, the middle pin to an analog pin, and the right pin to GND.

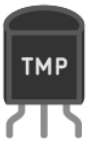

Fig. 5. TMP36 temperature sensor

LEDs are semiconductor diodes that emit light at direct polarization and have pins of different lengths, the long one is called the anode (+), and the short one is called the cathode (-).

The value of the current used to light a 5 mm LED is 20 mA (direct polarization).

An LED connects to the Arduino Uno board as follows: the left pin (right pin) connects to the GND, and the right pin (bent pin) connects to a 220 Ω resistor and the latter connects to a digital pin. The RGB LED has four legs, as shown in the picture, but can have two.

The RGB LED changes color to red-green-blue in succession when connected to a battery. At maximum intensity (255) it displays white, and at minimum intensity (0) it displays black. By combining LOW (0) and HIGH (1 ... 255) we can get any color.

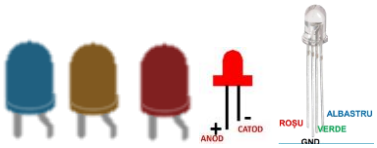

Fig. 6. LED

Connecting wires, fig. 7, are wires that connect the BreadBoad to the Arduino Uno board and mediate the connections between the electrical elements assembled on the BreadBoard (with the «+» and «-» zones). They can be of three types: male-male threads, female-male threads and female-female threads.

Fig. 7. Connecting wires

Figure 8 shows the power cord that connects the Arduino Uno board to the computer or laptop.

Fig. 8. Power wire

For the two mechatronic applications, resistors with a value of 220 Ω are also used, which have the role of limiting the electric current, i.e., to control its value, protecting the components to which the resistors are inserted.

To calculate the value of a resistor you need the color code and knowledge of the meanings of the lines on the resistor, so that: the first 2 lines represent the value of the resistor, the third represents the multiplier, and the last represents the tolerance. Correct reading of the value of a resistor is done from left to right, never from the gold or silver lines (these colors are specific to the meaning of tolerance).

Fig. 9. Resistor

The buzzer, illustrated in fig. 10, is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, tension, or force, turning them into an electric charge. The principle of operation is that the alternating audio frequency voltage is applied to the armature of the piezoelectric element. The element begins to oscillate mechanically at the same frequency. The oscillations are transmitted to the membrane fixed rigidly by the piezoelectric element, which produces sound vibrations.

Fig. 10. Buzzer

The HC-SR04 ultrasonic sensor is a sensor used to measure distance or to detect objects. It emits ultrasound at a frequency of 40,000 Hz flowing through the air, and if it encounters an obstacle it will return to the mode, thus taking into account the speed of sound, the distance to the object can be calculated.

Fig. 11. HC-SR04 ultrasonic sensor

The first part of the study refers to the mechatronic assembly that measures the temperature, displays it on the 16x2 LCD screen and makes a light signal through one of the three LEDs mounted depending on the temperature range in which the detected value is.

This assembly can be used in various fields of activity, such as: for domestic use, in agriculture (greenhouses), in industry - thermal power plants, cars, etc. [2].

Figure 12 shows the modeling in the specialized software application TINKERCAD of the mechatronic assembly for temperature measurement and its display on a 16x2 LCD screen, with the facility of visual warning of critical temperature ranges (by connecting and assembling electronic components necessary for optimal operation of the first application).

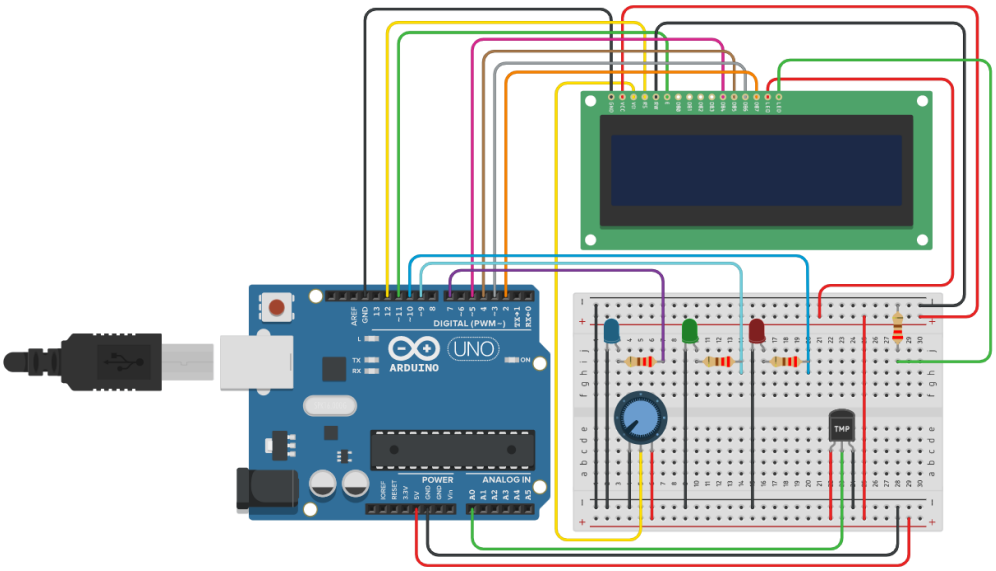

Fig. 12. Making the first mechatronic assembly, by connecting and assembling specific components

The mode of operation of the application developed for the first mechatronic assembly is as follows: the TMP36 temperature sensor, which can measure in the range -40ºC… + 125ºC, will transmit to the 16x2 LCD screen the detected temperature and, depending on its value, we have the following situations:

– the blue LED will light up if the temperature ("Tmp") falls in the temperature range -40ºC to + 10ºC;
– the green LED will light up, if Tmp falls in the temperature range + 11ºC to + 30ºC;
– the red LED will light up if Tmp is in the temperature range + 31ºC to + 125ºC.

For example, Figure 13 shows the three situations listed above, made through the Simulation Module of the specialized software application TINKERCAD.

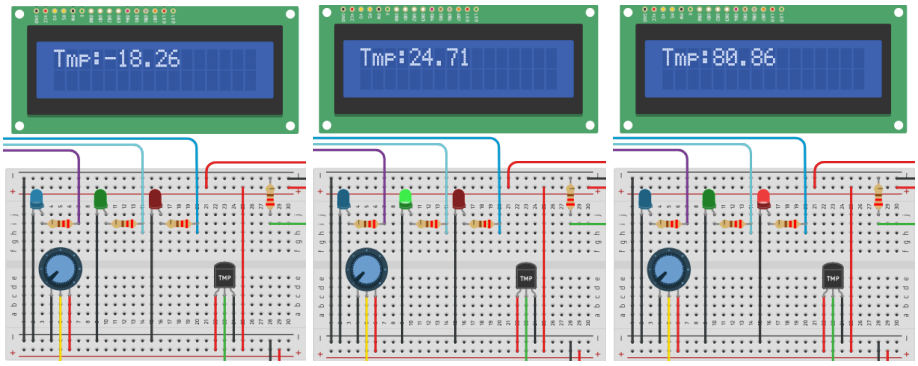

Fig. 13. Simulation of LED lighting and distinct messages displayed,
depending on the temperature measured for the first mechatronic modeled assembly

The authors also developed a programming code in the TINKERCAD virtual software application, for transmitting messages on Serial Monitor, for the three distinct temperature ranges, such as: “COLD!”,

“MODERATE!” and “HOT!” depending on the temperature indicated in real time by the specialized sensor on this mechatronic assembly.

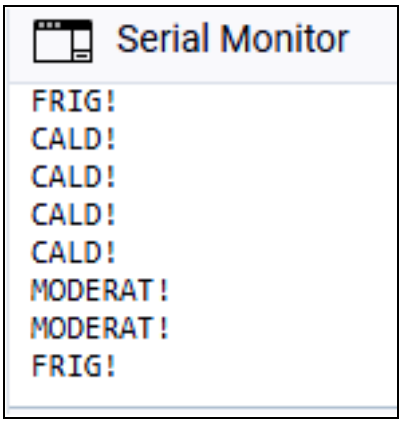

Fig. 14. Messages sent to the Serial Monitor by the temperature sensor

In order for the LCD application for the first mechatronic assembly to work under the conditions presented above, the following developed programming code is required:

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(12,11,5,4,3,2);
float value;
int tmp = A0;
int LED1 =7;
int LED2 = 9;
int LED3 = 10;
const int FRIG = 10;
const int CALD = 30;

void setup()
{pinMode(tmp,INPUT);
  pinMode(LED2, OUTPUT);
  pinMode(LED3, OUTPUT);
  Serial.begin(9600);
  Serial.println("Secvență nouă");
  randomSeed(analogRead(A0));}

void loop()
{value = analogRead(tmp)*0.004882814;
 value = (value - 0.5) * 100.0;
  lcd.setCursor(0,1);
  lcd.print("Tmp:");
  lcd.print(value);
  delay(1000);
  lcd.clear();
if (value < FRIG)
{digitalWrite(LED1, HIGH);
  digitalWrite(LED2, LOW);
  digitalWrite(LED3, LOW);
  Serial.println("FRIG!");}
else if (value > CALD)
{digitalWrite(LED1, LOW);
  digitalWrite(LED2, LOW);
  digitalWrite(LED3, HIGH);
  Serial.println("CALD!");}
else
{digitalWrite(LED1, LOW);
  digitalWrite(LED2, HIGH);
  digitalWrite(LED3, LOW);;
  Serial.println("MODERAT!");}}
```

The second part of the study refers to the realization of the mechatronic assembly that measures the distance, displays it on a 16x2 LCD screen and warns, both visually, by lighting some LEDs, and acoustically, by emitting sounds by a buzzer at certain distances. This assembly can be used in various fields of activity, such as: in industry - aeronautics, automobiles, intelligent robots, etc. [3].

Fig. 15 shows the realization by modeling in the specialized software application TINKERCAD of the mechatronic assembly for measuring the distance by displaying it on a 16x2 LCD screen, with the facility of sound and acoustic warning of critical values (by connecting and assembling the electronic components necessary for optimal operation). second mechatronic applications).

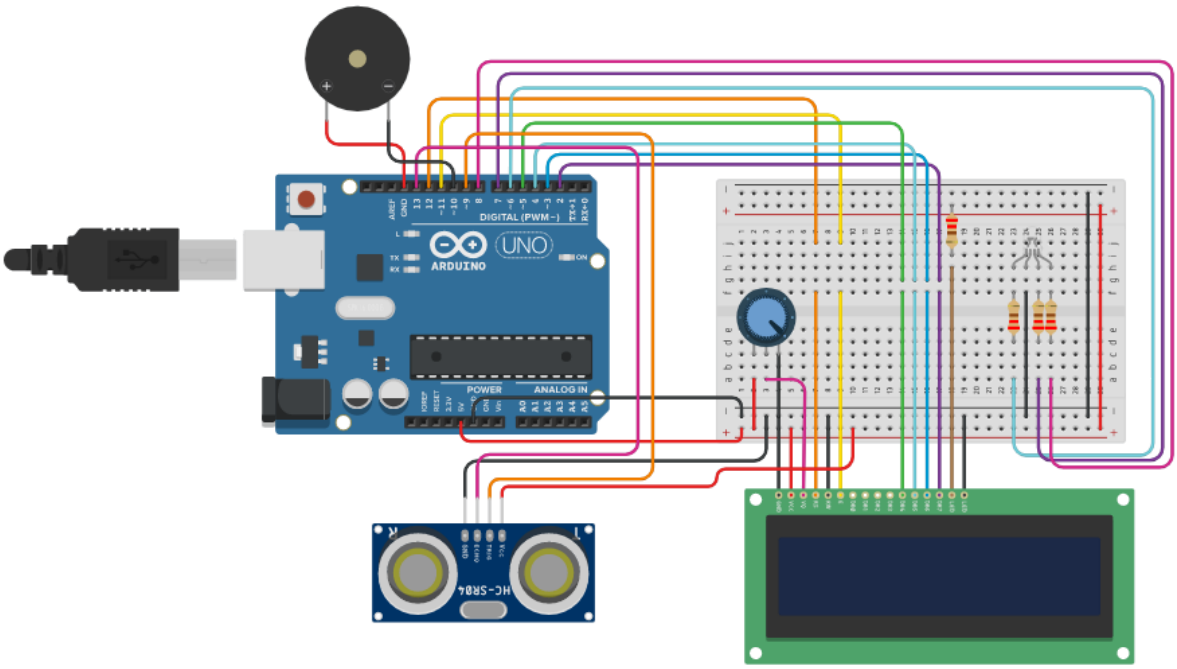

Fig. 15. Making the second mechatronic montage, by connecting and assembling specific components

The mode of operation of the application developed for the second mechatronic assembly is as follows:

- the ultrasonic sensor HC-SR04 transmits the measured distance up to an obstacle to the 16x2 LCD screen and, depending on the value of this measured distance, we have the following situations:
  - the LED lights up in green, if the distance ("Distance") is in the range of 400 cm to 50 cm;
  - the LED lights up in yellow, if the distance is in the range of 50 cm to 10 cm, and the buzzer emits a loud sound at a frequency of 500 Hz - to warn of danger!
  - the LED lights up in red, if the measured value is less than or equal to 10 cm, and the buzzer in this case emits a high sound at a frequency of 1000 Hz - to warn of high danger!

For example, the three situations listed above are shown in Figs. 16, made through the Simulation Module of the specialized software application TINKERCAD.

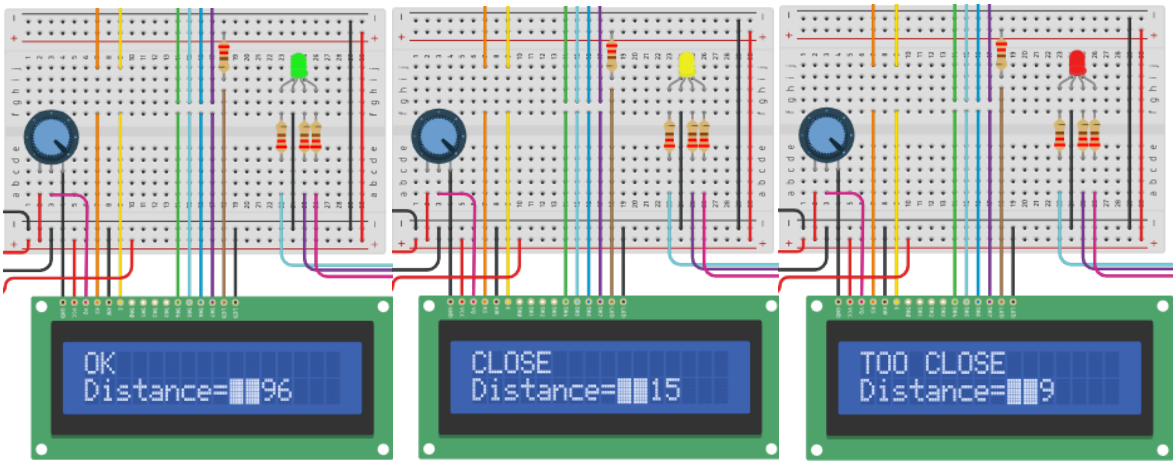

Fig. 16. Simulation of LED lighting and distinct messages displayed, depending on the distance measured, for the second mechatronic assembly made by modeling

In order for the LCD application for the second mechatronic assembly to work under the conditions presented above, the following developed programming code is required:

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
int red=6;
int blue=7;
int green=8;
const int trigger = 9;
const int echo = 13;
int buzzer = 10;
int distance;
long duration;

void setup()
{Serial.begin (9600);
 pinMode (trigger, OUTPUT);
 pinMode (echo, INPUT);
 pinMode (buzzer, OUTPUT);
 lcd.begin(16, 2);
 pinMode(red, OUTPUT);
 pinMode(green, OUTPUT);
 pinMode(blue, OUTPUT);}

void loop()
{digitalWrite (trigger, LOW);
  delayMicroseconds (2);
  digitalWrite (trigger, HIGH);
  delayMicroseconds (10);
  digitalWrite(trigger, LOW);
  duration = pulseIn(echo, HIGH);
  distance = duration*0.034/2;
if (distance <400 && distance >50)
{digitalWrite(blue, LOW);
  digitalWrite(red, LOW);
  digitalWrite(green, HIGH);
  digitalWrite(buzzer, LOW);
  noTone(buzzer);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.println ("Distance=");
  lcd.print (distance);
  delay (500);}
else
{if (distance <50 && distance >10)
{digitalWrite(blue, LOW);
  digitalWrite(red, HIGH);
  digitalWrite(green, HIGH);
  digitalWrite(buzzer, HIGH);
  tone(buzzer,500);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("CLOSE ");
  lcd.setCursor(0,1);
  lcd.println ("Distance=");
  lcd.print (distance);
  delay (500);}
else
{if (distance <=10)
{digitalWrite(blue, LOW);
  digitalWrite(red, HIGH);
  digitalWrite(green, LOW);
  digitalWrite(buzzer, HIGH);
  tone(buzzer,1000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("TOO CLOSE ");
  lcd.setCursor(0,1);
  lcd.println ("Distance=");
  lcd.print (distance);
  delay (500);}}}}
```

3. Conclusions

The objective proposed at the beginning of the modeling and simulation study was fulfilled by the authors, by creating with the help of modeling in the virtual software application TINKERCAD the two mechatronic assemblies separately, and their operation was highlighted by simulating the behavior of this assembly in real operation. To achieve this goal, the authors went through the following steps: determining the components needed for the two assemblies, properly assembling all the electronic components needed for modeling, developing programming codes for LCD displays, and finally simulating how the assemblies work. in operating conditions similar to the real ones.

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CONCEPTS OF ELECTRONIC SIGNATURE AND ONLINE TRAINING IN THE OCCUPATIONAL SAFETY AND HEALTH

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SUMMARY: The current health crisis has amplified the digitalization process. In this context of remote work, many companies have or wish to use the electronic signature and they also implemented online training through the e-learning platform. Digitization can rapidly change the world of work and the digital work platforms create opportunities for workers and employers and also challenge, new and updated solutions for occupational safety and health (OSH). In order to create a modern image that respects the environment, the electronic signature saves ink and paper and increases profitability. As well, this concept gives us better security regarding the following aspects : the identification of the interlocutors is confirmed, reduces the risk of falsification, missing documents, loss of information. So, it saves us paper, time and make our job much easier.
The electronic signature of a document has the same legal value as a handwritten signature. Digitization is the key to optimizing work processes, managing work-related risk, protecting health and improving productivity.

KEY WORDS: Digitalisation, strategy, digital platform, electronic signature, online training

1. Introduction

This study addresses an important issue, namely the implementation of digitization in certain areas of activity, and employees need to be sufficiently and adequately trained in terms of Occupational Safety and Health.

In order to move towards this technology of the future, many projects are underway at both European and national level, based on a well-defined legislative framework that allows for the sound management and ease of implementation of two concepts of a major interest: electronic signature and online employee training.

Thus, in Romania, in 2020, the (governmental) Authority for the Digitization of Romania (ADR) was established.

The e-signature development initiative can be found in the European eIDAS Regulation: “Electronic IDentification, Authentication and Trust Services (eIDAS) is a European regulation on electronic identification and trust services for electronic transactions in the European single market. It was established by EU Regulation 910/2014 of 23 July 2014 on electronic identification and repeals Directive 1999/93 / EC of 13 December 1999. "

(*) Regulation n° 910/2014 of July 23, 2014

By Government Emergency Ordinance no. 36/2021 (GEO no. 36/2021) introduced the possibility of using the advanced electronic signature or the qualified electronic signature, accompanied by the electronic time stamp or qualified electronic time stamp and the qualified electronic seal of the employer in the field of labor relations, and for amending and supplementing some normative acts.

It is also specified the possibility to prove the training in the field of occupational safety and health, in electronic format or on paper, depending on the method chosen by the employer and established by the internal regulations.

The EU's strategic framework governing OSH activities in the field of digitalisation has been under way since 2014 and the achievement of the objectives is set to run until 2027.

Challenges for the future of occupational safety and health (OSH):

- Communication from the Commission to the European Council "A strong and social Europe for just transitions" of 14 January 2020 entitled ‘A strong and social Europe for just transitions’
- Communication from the Commission to the European Council (Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee) "Artificial Intelligence for Europe" COM (2018) 237 - Communicatiom from the Commission to the European Parliament, the European Council, The Council, The European economic and social Committee and the Committee of the regions 'Artificial Intelligence for Europe'.
- EU-OSHA's Safe and Healthy Jobs Campaign entitled 'Safe and Healthy Jobs in the Digital Age', 2023-2025, raises awareness of digitalisation and occupational safety and health and raises awareness available more practical resources.

The healthy jobs campaign in the context of digitalization and all these projects include the premises of an advanced robotics (robot-worker interaction), new forms of worker management based on AI systems - algorithms, occupational analysis, remote work (policies and regulations in field), new monitoring systems for worker safety and health, etc.

2. Statistics resulting from the proviison of a respectful working environment adapted to teleworkers

An employee spends about 25% of his life at work (the period in which he is active on the labor market), so there is, statistically, a one in four chance that the ailments he suffers from will be related to his professional activity.

Taking into account the situation generated by the Covid-19 pandemic context, many organizations have implemented sustainability strategies to adapt to the remote / online interaction format or the hybrid model - a mix of telework and office, training methods using digital platforms .

The main concern of some banking organizations, among which we discuss two of them, namely BRD Romania and the Société Générale Group, was to ensure the safety and health of all its employees and to ensure the continuity of activities.

In order to ensure a healthy life for employees, programs have been created, at the level of internal organization within the companies, namely: "Responsible Employer" Program, "Life at Work", which promotes quality of life, health and prevention, adequate work environment , identification of psycho-social risks, telework and new methods of organization.

Below are presented the real situations of work accidents, respectively occupational diseases registered in the period 2018-2021, within the banking companies mentioned above.

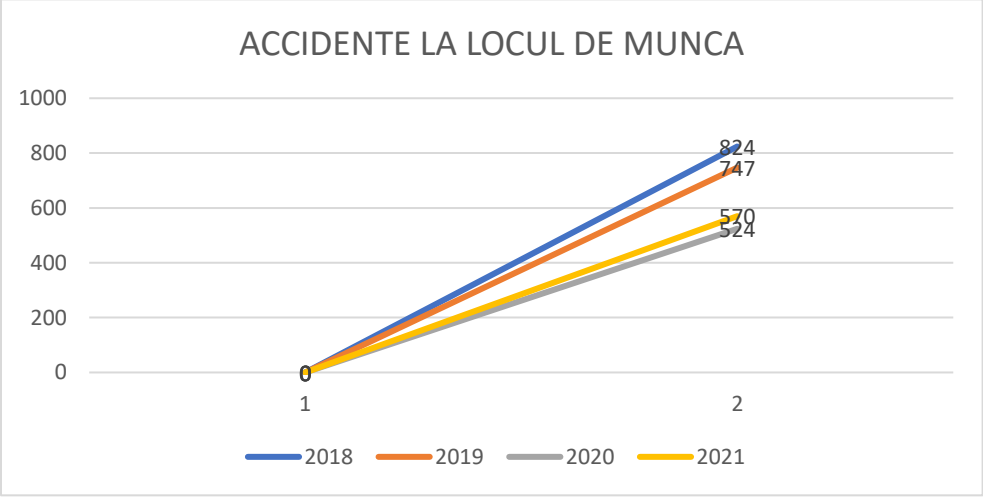

Fig. 1 [HEALTH AND SECURITY AT THE WORKPLACE - 2021 Report Grup Société Générale]

From the analysis of the data in Fig. 1 we can observe that:

- There is a considerable decrease in accidents at work from 2018 to 2020.
- In 2021, the number of accidents at work increased compared to 2020, which means that not all workers have acquired knowledge about the protection and prevention of health at work.

Tabel 1 - Work-related accidents – BRD Romania

Employee	U.M	2019	2020	2021
Deaths caused by work-related accidents	Number	0	0	0
Work related accidents with significant consequences (excluding deaths)	Number	14	8	2
Registered work accidents	Number	14	8	2
The main types of accidents at work	Text	bone fractures	bone fractures	bone fractures

Tabel 2 - Occupational diseases– BRD Romania

Employee	U.M	2019	2020	2021
Deaths due to occupational diseases	Number	0	0	0
Occupational diseases registered	Number	0	0	0
Main types of occupational diseases	Text	N/A	N/A	N/A

Analyzing the results in Table 1, it appears that the number of accidents at work has decreased from year to year.

There were also no deaths from these accidents, but the main type of accident each year was a fracture.

And in the case of occupational diseases, the statistics found in Table 2 show that there were no occupational diseases or deaths due to occupational diseases.

From these statistics, it can be deduced that:

- The implementation of the activities strictly respects the provisions of the Romanian Law no. 319/2006 and assesses the risk on the components of the work system.
- The assessments are performed by the specialists of the Internal Health and Safety Service, who are certified for the assessment of occupational risks through a specific postgraduate program authorized by the Romanian Ministry of Education, and the occupational health doctor.
- All employees have been and continue to be trained on health and safety risks related to jobs and what is the communication flow in case of accidents at work and occupational diseases. These training activities take place annually and may also include e-learning and face-to-face training. All employees are trained in occupational health and safety and on a regular basis - every six months for executive positions and every year for managers.
- A dedicated e-learning course related to health and safety at work is provided to all employees. Employees must take this e-learning course during working hours. After taking this elearning course, the employee must go through an assessment that requires at least 70% correct answers.
- In addition, after training accidents, additional training courses are provided.

3. What is and how the digital platform work?

The digital platform is a complex process, a working tool that allows the generation and uploading of the necessary documentation to compile the personal file of the employee, to perform all the training provided by law.

To validate and give legal value to documents, we need an electronic signature. The platform is connected to various service providers qualified in this way. Electronic documents are only valid in the electronic environment.

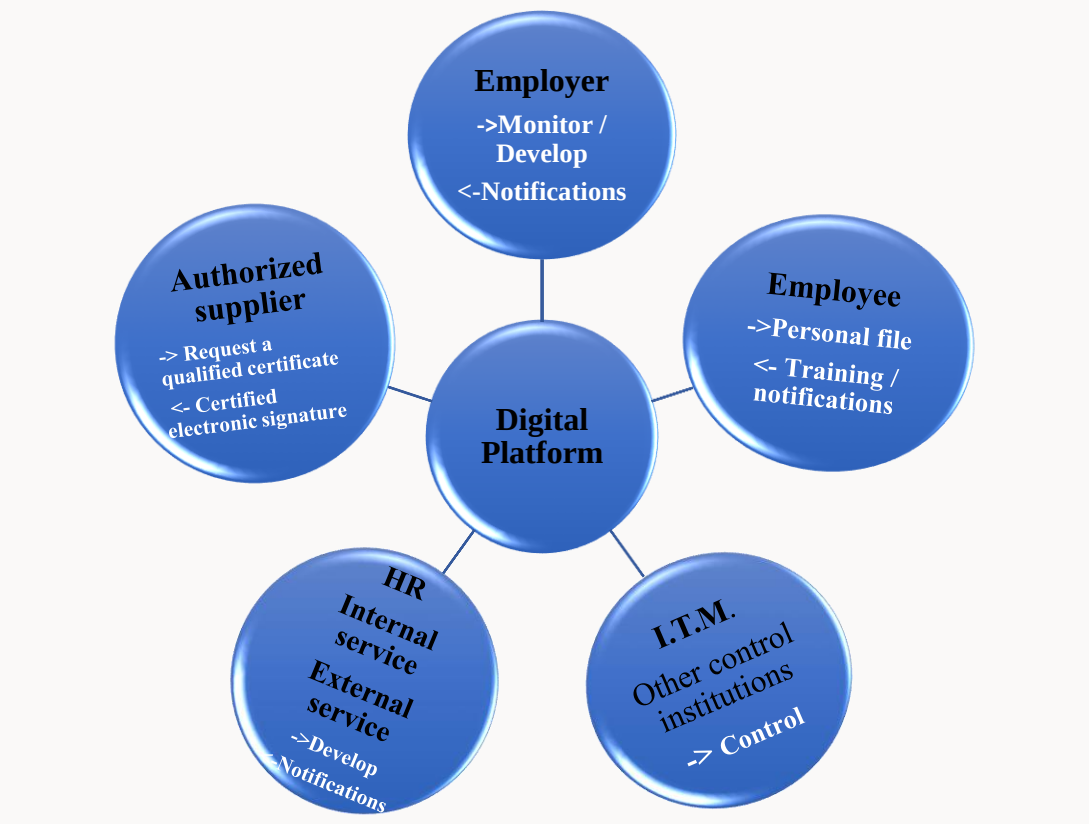

Fig. 2 Interconections on digital platform

The interface of the platform is intuitive and simple which gives us flexibility and time saved.

The steps for using it are as it follows:

- Connection
- Completing the profile
- Generating / Uploading documents
- Online training and testing of employees' knowledge
- Electronic signature

Thus, the information is organized, the documents are secured and everything is done with a single click.

Each employee easily logs into the system, always knows what courses he has taken and what percentage he has until he completes them.

The application sends notifications and informs you what to do (eg work medicine is not loaded), the revisal can be uploaded to the platform, the company organization chart can be made and to facilitate the work of HR, the employees' file can be structured - function groups , departments, specific documents for each employee.

Video conferencing can be created for training or because each employee has a registered email address, the employer generates and submits a training. The topics are selected and the instructions must be signed electronically by the employer before sending the form to the employees. By using this application, employees will be better trained.

The replacement of the classic environment with the digital one mainly aims, in addition to efficiency, to optimize costs and time, aspects analyzed in the table below:

Tabel 3 – [Training cost comparison]

	Clasic training			Online training	
	Price (lei)	Unit	Price (lei)	Unit	Price (lei)
Time allocated for completing the training papers	24 lei / hour	6 min	2.4	1	0.4
Time spent on actual training	24 lei / hour	2 h	48	1	0.4
Materials used in training	2	1	2	0	0
Transport	2 lei / km	10 km	20	0	0
Cost of using the online platform	1 / employee	0	0	1	1
Electronic signature	0.4				1.2
Total Cost	**72.4**			**3**	

This table shows that the digitization of the OSH system, including online training of workers, is characterized by words such as flexibility, mobility, care and protection of the environment, economy of resources (material, financial and human), plus time savings, which results in cost and time efficiency for all parties involved.

4. Conclusions

As we move into the world of digitalization, the field of OSH cannot remain in the era of the pencil. This digital industrial revolution will focus on the benefits to companies and people. The main issues are improving connectivity, data security and developing a European cloud.

Workers must be aware of the risks to which they are exposed as a result of accidents at work and occupational diseases and make an effort to maintain their physical and mental integrity in this context and in the face of challenges, which can only be achieved through a continuous information and education process. However, the exchange of information and the dissemination of good practices, as well as guidance and control from ITM, should be encouraged.

The concept of telecommuting has become the focus of global attention because it has become a long-term solution, amplified by the Covid health crisis 19.

The European Strategic Framework on OSH also anticipates the possible negative effects of new technologies and changes in the organization of work on workers' safety and health.

Projects of the planned and ongoing National Agency include topics such as: advanced robotics and AI-based task automation, automation of cognitive and physical tasks, changing job content, collaborative robots - direct interaction between human and robot, new forms of management workers 'activities, algorithm-based systems, analysis, knowledge through complex games-knowledge, new monitoring systems for workers' health and safety.

In the medium and long term, we want to change the potential of the work environment, the mentality, the acquisition of skills to manage, to use the new tools that involve an improvement of e-learning.

Digitization helps to develop performance and allows unlimited solutions within companies, helps to create new business concepts, which means progress but to achieve this goal, the interest must be common, both on the part of the employee and the employer and desire to adaptation.

To help companies that do not have a budget and want to use modern tools, there is the European Non-Reimbursable Financing Program - Digitization of SMEs.

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NOISE EXPOSURE FOR GROUND OPERATIONS MARSHALLER IN INTERACTIONS WITH SMALL AIRCRAFTS

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Synopsys: Case study about noise exposure, measurements and actions to prevent noise exposure for the ground operations, workplace at the airport. The noise level is determined by measuring the sound pressure, which is expressed in Decibels (dB). As the number of decibels increases, the noise becomes harder to bear. The human ear can perceive sounds with an intensity between 0 and 120 decibels. Usually, the level of 20-30 decibels is harmless to the human body and as it grows, it becomes tiring or stressful (especially in the case of exposure for a longer period of time).
KEYWORDS: Noise exposure, measurements, measures, prevention

1. Introduction

Noise in the workplace is a widespread global issue. In Europe, for example, tens of millions of workers have hearing problems caused by high-noise work environments. Approximately one third of the total occupational diseases registered both in Romania and in the European Union are represented by hearing loss caused by noise.

But what exactly is noise? Noise is a form of noise pollution consisting of polluting hearing aids (sounds) that, in duration and amplitude, can harm health through hearing disorders. Noise is mainly produced by the operation of industrial equipment, especially motorized ones but also by strongly amplified music. Some of the health conditions caused can have irreversible effects on the human body. The following are some examples of the effects of noise exposure, as per the Noise Exposure Risk Prevention Campaign conducted by the Romanian Labor Inspectorate [1]:

- Hearing loss - deafness, caused by the destruction of the inner ear's cilia.
- Tinnitus - is the annoying auditory sensation of whistling, hissing, whining, humming.
- Disruption of verbal communication - Ambient noise is often felt as a disruption of verbal communication, especially if the listener is already hearing impaired or if ambient noise covers the speaker's voice.
- Increased risk of injury - Noise is a risk of injury as it may prevent workers from hearing and / or understanding communication and signaling correctly at work or in traffic. For example, noise may distract from the audible warning signal of imminent danger or may generally distract, especially in the case of drivers.
- Psychological disturbances - ambient noise can be very disturbing, especially when the worker is carrying out an activity that involves focusing attention. The frequency of errors and uncertainty increase if the activity takes place in a noisy environment.
- Physiological effects - Exposure to noise can cause fatigue, digestive, cardiovascular (high blood pressure) and neuropsychiatric (stress) disorders.

Considering the effects caused by exposure to noise on the human body, the legal provisions aim to reduce the risk of hearing loss by reducing the noise level, preferably at the source, and by using hearing protection equipment.

2. The current stage

In a concerted effort to combat the effects of noise exposure of workers, the European Union has updated the previous Noise Directive 86/188 / EEC with a new Directive 2003/10 / EC which:

- provides increased protection for workers in all sectors of the economy, including the maritime and air transport sectors (excluded from the existing Directive 86/188/EEC).

- recognizes the specificity of the music and entertainment sectors by providing for a two-year transitional period during which codes of conduct shall be established for helping workers and employers in these sectors to meet their legal obligations as laid down by the directive.
- reduces the exposure limit value from 90 dB(A), as set up in the 1986 directive, to 87 dB(A), which represents clear progress.

In Romania, the minimum requirements regarding the exposure of workers to noise are specified by GD (government decision) 493/2006, a decision which took over the provisions of EU Directive 10/2003.

GD 493/2006 set out the minimum requirements for the protection of workers from the risks arising from exposure to noise, in particular against the risks of hearing. The provisions of this decision also apply to all activities in which workers are or are likely to be exposed by the nature of their work to the risks generated by noise.

The physical parameters used as risk factors are as follows:

- the level of daily noise exposure $(L_{Ex,8h})$ (dBA) – time-weighted average of noise exposure levels for a nominal working day of 8 hours.

This notion covers all the noises within the workplace, including impulse noise.

- weekly noise exposure level $(L_{Ex,8h})$ (dBA) time-weighted average daily noise exposure levels in a nominal 5 days' work week of 8 hours each day.

The exposure limit values and the values from which the employer's action on health and safety protection of workers is triggered are as follows:

- exposure limit values: $L_{Ex,8h}$ = 87 dBA and peak pressure $p_{vârf}$ = 200 Pa (Pascals)
- upper exposure limit values from which the action is triggered: $L_{Ex,8h}$ = 85 dBA and peak pressure $p_{vârf}$ = 140 Pa (Pascals)
- lower exposure limit values from which the action is triggered: $L_{Ex,8h}$ = 80dBA and peak pressure $p_{vârf}$ = 112 Pa (Pascals)

3. Noise determinations at Ground Operations company

The noise exposure assessment is one of the concerns of Ground Operations company, as a first step in anticipating workplace noise hazards and the application of prevention principles and has been carried out in accordance with the legal requirements [2], [3], [4] and the applicable standards [5].

Fig. 1. Dauphin helicopter

The benefits of noise measurement are very important because it allows a scientific and accurate analysis of hurtful noise.

Acoustic measurements clearly indicate the extent to which hearing loss may be caused and allow corrective action to be taken. The measurements allow the analysis of noise and the elaboration of solutions, diagnoses in the program of reducing the exposure in the case of the

work environment but also outside it, all these leading to the improvement of the quality of life and human activity.

Fig. 2. ATR 45 aircraft

The method used for measuring and determining the noise exposure was that established by the standard SR EN ISO 9612: 2009 “Acoustics - Determination of occupational noise exposure - Engineering method”

Noise measurements are performed with special devices called sound level meters or dosimeters. The sound level meter is an instrument that has a response to acoustic signals of the same shape as the human ear. The dosimeter can be used for measurements in all types of work conditions.

This is the preferred method when performing long-term measurements for a mobile worker who is engaged in complex or unpredictable tasks or who performs a large number of direct tasks.

The sound level meter can be used to measure a single or multiple tasks within fixed work places. The microphone must be mounted above the shoulder at least 0.1 m from the entrance to the inner ear canal, on the side with the ear most exposed, and must be at least 0.04 m above the shoulder.

In this case, the following portable devices were used to determine and evaluate the noise exposure (Figure 3):

Fig.3. Portable noise measuring devices

- Brűel&Kjaer dosimeter type 4448 (Figure 4);
- Brűel&Kjaer acoustic calibrator type 4231;
- Brűel&Kjaer sound level meter type 2250;

The equipment used complies with the legal requirements on metrological verification and calibration according to SR EN ISO 170254/2005 and has been calibrated with the Brűel&Kjaer acoustic calibrator type 4231.

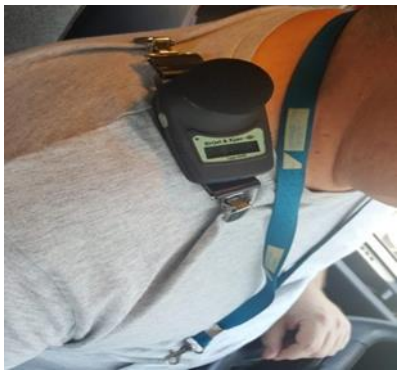

Fig 4. Brűel&Kjaer dosimeter type 4448

Analysis and interpretation of the results of noise determinations

The analysis and interpretation of the results of the noise determinations were based on them:

- the measurements carried out,
- the specific activities carried out by the workers,
- the measurement method established by SR EN ISO 9612" Acoustics - Determination of occupational noise exposure - Engineering method "
- minimum legal requirements established by GD 493/2006, amended and supplemented by GD 601/2007

In this regard, the actual day-to-day noise exposure was taken into account in determining the equivalent continuous noise level and the information provided by Ground Operations company on the representative duration of exposure specific to each activity performed by the workers.

The following are the noise test reports and measurement results for airplane guiding activities (Table 1. and Table 2.), helicopter guiding activities (Table 3. and Table 4.) and auxiliary activities (Table 5. and Table 6)

Table 1. Noise test report - airplane control activities

Used method	Measurements performed in accordance with SR EN ISO 9612:2009
Measurement location	Otopeni Airport – Marshalling Operations and Control Department
Measurement conditions	Normal working conditions
Measurement period	05/07/2021 – 09/07/2021
Job description	Job: aircraft marshaller
	Schedule: 12h/shift
	Neuropsychic and psychosensory stress: Especially for dispatching activity
Used equipment	Dosimeter Brűel&Kjaer type 4448
Minimum requirements	Maximum permissible limit for daily noise exposure according to GD 493/2006: 87 dBA
	The maximum allowed limit for jobs with special neuropsychic and psychosensory stress, according to GD 493/2006, amended and supplemented by GD 601/2007, is 60 dBA

Table 2. Measurement results - aircraft control activities

Activity	Registered value L_{ech} (dBA)	Exposure time /shift/week

Steering on the platform with the KIA Sportage car at ATR 45 aircraft	86,9	3 h.
Platform steering with KIA Sportage at Boeing 737 aircraft	89,2	
Direction and monitoring activities, control tower enclosure	65,2	3 h.

Daily exposure: $L_{E,z}$ = 87dBA

The analysis and interpretation of the results has taken into account the existing working conditions at the time of the noise determinations allowing the following interpretations:
- Daily noise exposure does not exceed the maximum permissible limit;
- The noise level in the dispatcher does not fall within the maximum limit of 60 dBA according to GD 601/2007

Table 3. Noise test report - Helicopter traffic services

Used method	Measurements performed in accordance with SR EN ISO 9612:2009
Measurement location	Otopeni Airport – Marshalling Operations and Control Department
Measurement conditions	Normal working conditions
Measurement period	12/07/2021 – 16/07/2021
Job description	Job: aircraft marshaller
	Schedule: 12h/shift
	Neuropsychic and psychosensory stress: Especially for dispatching activity
Used equipment	Dosimeter Brűel&Kjaer type 4448
Minimum requirements	Maximum permissible limit for daily noise exposure according to GD 493/2006: 87 dBA
	The maximum allowed limit for jobs with special neuropsychic and psychosensory stress, according to GD 493/2006, amended and supplemented by GD 601/2007, is 60 dBA

Table 4. Measurement results - Helicopter control activities

Activity	Registered value L_{ech} (dBA)	Exposure time /shift/week
Steering on the platform with KIA Sportage car on the Falcon 10 aircraft	78,8	15 min.
Platform steering with the KIA Sportage FollowMe1 at the Dauphin helicopter (Figure 1)	80,3	30 min.
Directing and monitoring activities, outdoor office premises	70,9	8 h + 30 min.

Daily exposure: $L_{E,z}$ = 72 dBA

The analysis and interpretation of the results has taken into account the existing working conditions at the time of the noise determinations allowing the following interpretations:
- Daily noise exposure does not exceed the maximum permissible limit;
- The noise level in the dispatcher does not fall within the maximum limit of 60 dBA according to GD 601/2007

Table.5. Noise test report - auxiliary activities

Used method	Measurements performed in accordance with SR EN ISO 9612:2009
Measurement location	Otopeni Airport – Marshalling Operations and Control Department
Measurement conditions	Normal working conditions
Measurement period	19/07/2021 – 23/07/2021
Job description	Job: Deputy Commander
	Schedule: 12h/shift

	Neuropsychic and psychosensory stress: Outstanding for office work
Used equipment	Dosimeter Brűel&Kjaer type 4448
Minimum requirements	Maximum permissible limit for daily noise exposure according to GD 493/2006: 87 dBA
	The maximum allowed limit for jobs with special neuropsychic and psychosensory stress, according to GD 493/2006, amended and supplemented by GD 601/2007, is 60 dBA

Table.6. Measurement results - auxiliary activities

Activity	Registered value L_{ech} (dBA)	Exposure time /shift/week
Outdoor office activities	70,8	4 h.
Surface monitoring activities in the KIA Sportage	72,4	4 h.

Daily exposure: $L_{E,z}$ = 71 dBA

The analysis and interpretation of the results has taken into account the existing working conditions at the time of the noise determinations allowing the following interpretations:

- Daily noise exposure does not exceed the maximum permissible limit;
- The noise level in the dispatcher does not fall within the maximum limit of 60 dBA according to GD 601/2007

Proposed measures to reduce workers' exposure to noise-related risk factors

Noise determinations performed at Ground Operations do not show values above the maximum permissible noise exposure limit at the workplace.

Fig 5. Ground marshalling

Even if the daily noise exposure is not exceeded, during the noise measurements there have been identified values above the lower and upper permissible maximum limit from which the action is triggered according to the legal provisions [7] at Otopeni Airport (see noise test reports).

Fig 6. Platform guidance

Also, during the performance of specific work tasks, such as those of the road maintenance personnel, the noise levels during the operation of various equipment (e.g. jackhammer, compactor plate, joint cutter, cleaning machine, marking machines, tractor with shredders, mower) has values above the maximum permissible limit of 87 dBA.

In both of the above situations, in order to reduce noise exposure, the employer will apply the legislative provisions regarding the reduction of noise exposure. [8]

Another situation is represented by the noise level determined in certain rooms existing at the workplace, such as: control tower ground dispatcher, office - deputy commander, container - ground dispatcher, which exceeds the value of the level of continuous noise equivalent L_{ech} daily 60 dBA set of GD 601/2007 [9] on jobs with special neuropsychic and psychosensory demands. In this case the employer will apply the legal prevention measures regarding the reduction of the risks generated by the noise exposure. [11]

Exposure to noise above certain limits is a factor of professional deafness, a biological aggression, a medical-social nuisance with implications of prime importance in terms of health and work capacity. The strong noise sources existing at the investigated workplaces put their mark on the daily exposure of the workers during the whole work shift.

1. Conclusions

The necessary measures to be taken to create a workplace environment in terms of noise protection at work on the airport platform are, in principle: noise risk assessment, prevention of exposure, including the use of personal protective equipment, limitation of exposure to noise in accordance with the exposure limit levels and the levels from which the action is triggered and the information, consultation and participation of workers. Beyond the solutions adopted, be they technical and / or organizational, to reduce exposure to noise, the following must be taken into account: avoiding the risk of occupational injury and illness, assessing the risks that cannot be avoided, combating risks at source, adapting tasks work for each worker, adapting to existing technical advances and replacing hazardous exposure with less hazardous or non-hazardous exposure;

In order to reduce cases of hearing loss due to noise, it is necessary to involve all parties directly or indirectly connected to the work process, namely: employers, workers, public authorities, health services, labor inspection services.

It is important to note that the Community strategy for health and safety at work, supported by the Council and the European Parliament, emphasized the idea of consolidating

and effectively enforcing Community law by applying all available levers to promote and acquire good practice beyond simple observance of the existing provisions [10].

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IMPROVING OPERATION AND MAKING PRACTICAL APPLICATIONS ON THE 3D PRINTER CREALITY ENDER 3

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ABSTRACT: After purchasing and using the FDM (Fused Deposition Modeling) 3D Printer Hobby Creality Ender 3, I have noticed some manufacturing malfunctions, which may be an impediment to making a part design under normal conditions and at the best print quality. The main factor that negatively influences printing is the construction of the filament roller holder. There have been identified problems which involve 3D printer operation using standard filament holder and a new one has been designed to optimize the printing process. The paper describes how to use the Creality Ender 3 3D printer using computer aided design applications such as SolidWorks and Cura Ultimaker.

KEYWORDS: 3D printer, computer aided design, optimization, process.

1. Introduction

In recent years, 3D printing technologies have became more and more known and used, this has led to the development of this field and the launch on the free market of many models of 3D printers, but also of components and accessories so that such a printer can also be made in-house by amateurs. In the open market, the cost of such a printer varies greatly from a few hundred dollars for a hobby printer to several tens of thousands of dollars for an industrial printer.

The printer used in this work is produced by Creality and it is a hobby printer. Following its use, some manufacturing deficiencies were found, which may be an impediment to making a part under normal conditions and at the best quality. The paper aims to expose these shortcomings and identify practical solutions to optimize the printing process.

2. Current stage

3D Printing or layer-by-layer deposition is a process of making a three-dimensional object of any shape designed digitally. The 3D object is made by an additive process in which successive layers of material are deposited in various shapes. The difference between the 3D printing technique and the traditional method of making objects is that instead of cutting of excess material, the material is deposited in the desired shape from the beginning, without the need for further processing.

Three-dimensional printing is a technology introduced in 1980, when a Japanese doctor called Hide Kodama developed the first patent for rapid prototyping. Initially, the 3D printing process was called rapid prototyping, especially the fact that it allows the rapid creation of different prototypes of some products. The first 3D printer was created by Charles Hull in 1984, which allowed the creation of real objects based on digitally projected data. Hull's contribution was the STL (stereolithography) file format and the digital "slicing" and "infil" strategies common to many processes today. In 1986, Charles "Chuck" Hull was granted a patent for this system, and his company, 3D Systems Corporation, was founded and launched the first commercial 3D printer, the SLA-1 [1].

3D Printing Technology:

1. Fused deposition modeling (FDM);
2. Stereolithography (SLA);
3. Selective laser sintering (SLS);
4. Poly-Jet 3D Printing [2].

Fused deposition modeling (FDM)

In this project we chose as a 3D printing method, FDM (Fused Deposition Modeling).

In this 3D printing process, the starting material is usually in the form of a plastic wire, which is known as a filament. In fused deposition modeling, the filament is wound on a roller and it is pushed into the melting system by an extruder (motor). This continues until the material is extruded through the nozzle, the fused filament being applied to a heated printing bed. Each new layer will be deposited on top of another layer and attached to it thus forming the desired part [3,4].

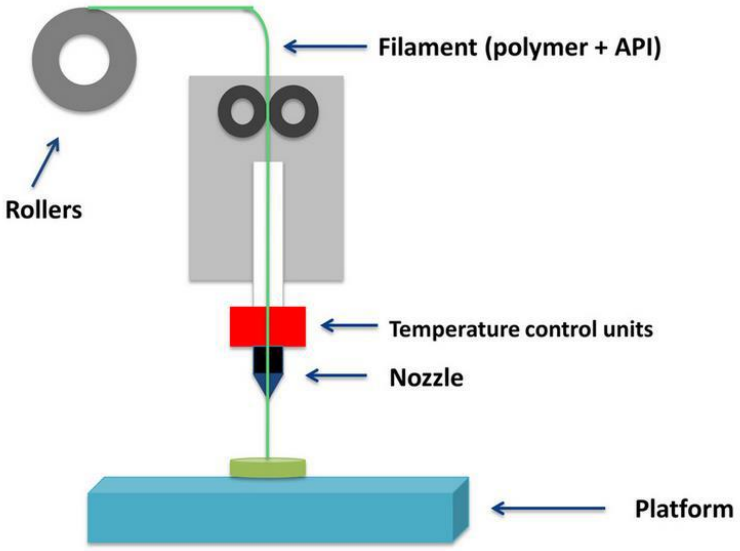

Fig. 1. FDM Technology [5]

This technology has the great advantage of the low price, both of the materials used for the actual printing, of the components of the 3D printer, as well as of the consumables. Such a printer is easy to buy and easy to use [6].

The main disadvantage of the FDM technique is that in the case of models with a high complexity from a geometric point of view, the speed of realization of the real object increases significantly but can also lead to the creation of small surface imperfections due to imperfect gluing of layers. Also, in the case of small parts, the resolution is not as good as in the case of really large parts.

The main applications of FDM modeling are: prototyping in various fields for testing purposes, making durable assemblies and subassemblies, conceptual design, production of household objects and much more [7].

3D Printer Creality Ender 3

Creality is a manufacturer of 3D printers from China, the company was established in 2014 and became known in 2018 with the launch of the Ender 3 printer, which is a budget hobby printer, very accessible to the general public [8].

This printer is a FDM technology (Fused Deposition Modeling). It is a simple printer, easy to assemble with high reliability and very good value for money. It is provided with a solid frame that provides rigidity and magnetic foil that facilitates the detachment of parts from the printing bed.

Machine Parameters:

Printing Size: 220*220*250 mm;

Filament: 1,75 mm:

Max Traveling Speed: 180 mm/s;

Machine Size: 440*440*465 mm;

Package Weight: 8 kg;

Max Nozzle Temperature: 255ºC;

Max Hot Bed Temperature: 110ºC;

Precision: ±0.1 mm;

Nozzle Diameter: 0.4 mm;

Layer Thickness: 0.1-0.4 mm;

Working Mode: Online/ Offline SD card;

File Format: STL, OBJ, G-code.

Fig. 2. Creality Ender 3 Printer [9]

3. Using the Creality Ender 3 printer

After using this 3D printer I noticed some deficiencies of the filament supply system:

1. The position of the filament holder on which the roller is mounted is wrong, the axis of the extrusion mechanism bushing and the axis of the filament forming a sharp angle so that there is a very high friction between the guide bush and the filament which is amplified by the type of filament (flexible filament is much tighter and the friction force is higher).
2. The filament holder on which the roller is placed is rigid and the sliding of the roller for feeding with filament is made similar to a bearing housing, thus making the load of the extrusion motor more difficult.

Using of this filament supply system may have the following consequences:

- Premature wear of the guide bush;
- Interrupt the printing process;
- Irregularities of the printed part;
- Extrusion motor failure.

To remedy these shortcomings and optimize the printing process, I rewrote the filament roller holder and mounted it in a position favorable to the extrusion motor. The new filament holder was designed in Solidworks 2016 and for the generation of the printing code, in order to make the parts physically we used the 3D slicer Ultimaker Cura 4.8.0.

The filament holder was made of PLA. I chose this material because it is not toxic, it does not emit toxic smoke when melting, which is an advantage when working in your own home. It is also easy to buy and its price is lower than other materials [10].

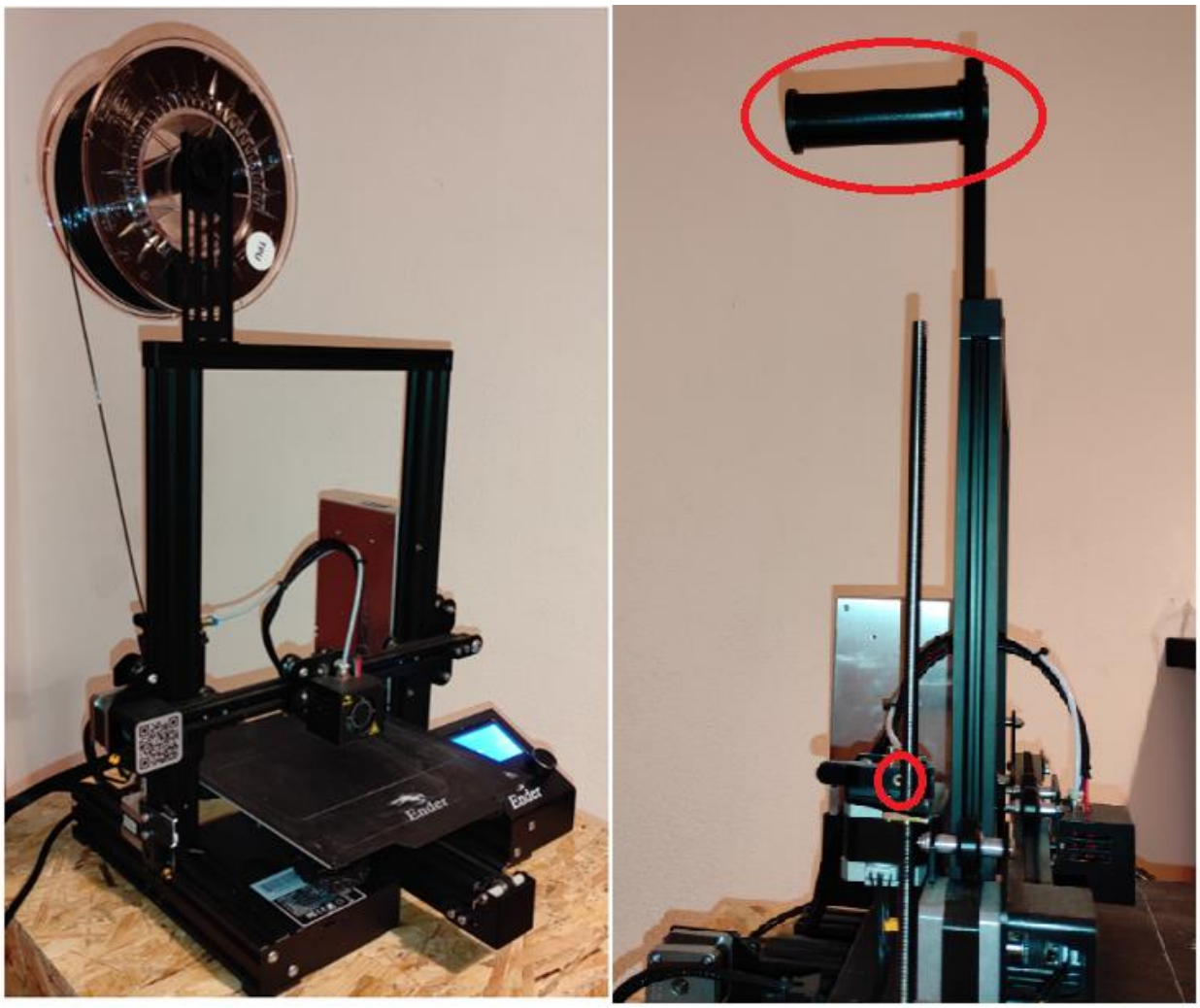

Fig. 3. Standard Filament Holder

Properties of PLA 3D filaments:

- The melting point for PLA is between 150 and 160 degrees Celsius and may depend on other materials added to give it texture or color;
- Vapors released during melting of PLA are non-toxic and do not have a strong smell;
- Hardness is high and flexibility is considered low;
- Easily adheres to many types of materials;
- It can also be used without a heated bed as a base, but if a bed is still used, it should be between 40 and 50 degrees Celsius [11].

4. Making the component parts and assembling the filament holder

The filament holder was designed in SolidWorks 2016 and the Cura Ultimaker 4.8.0 program was used to generate the printing code.

I decided that the position of the filament base holder would be on the side of the extrusion motor. For an easy assembly without other modifications to the printer, we measured and copied the aluminum profile from which the printer is made, and the new filament holder is mounted directly on it.

Fig.4. Holder Design

The 3D model was created in Solidworks and was imported into the Ultimaker Cure software to set the printing parameters and generate the G code program.

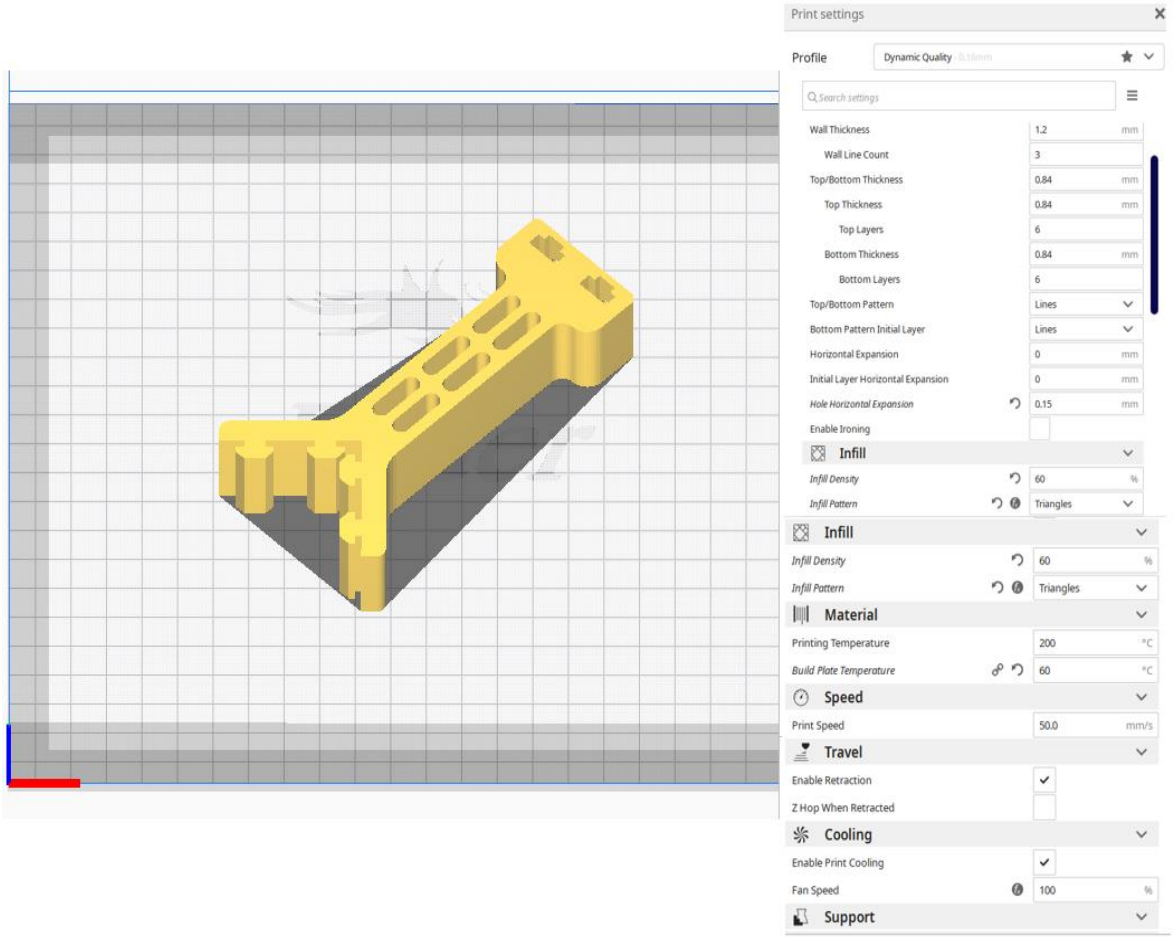

Fig. 5. Printing Settings

```
;Generated with Cura_SteamEngine 4.8.0
M140 S60
M105
M190 S60
M104 S200
M105
M109 S200
M82 ;absolute extrusion mode
; Ender 3 Custom Start G-code
G92 E0 ; Reset Extruder
G28 ; Home all axes
G1 Z2.0 F3000 ; Move Z Axis up little to prevent scratching of Heat Bed
G1 X0.1 Y20 Z0.3 F5000.0 ; Move to start position
G1 X0.1 Y200.0 Z0.3 F1500.0 E15 ; Draw the first line
G1 X0.4 Y200.0 Z0.3 F5000.0 ; Move to side a little
G1 X0.4 Y20 Z0.3 F1500.0 E30 ; Draw the second line
G92 E0 ; Reset Extruder
G1 Z2.0 F3000 ; Move Z Axis up little to prevent scratching of Heat Bed
G1 X5 Y20 Z0.3 F5000.0 ; Move over to prevent blob squish
```

Fig. 6. G-code

I have developed a new filament roller holder system. To facilitate the filament supply by reducing the stress exerted by the extrusion motor, I decided to use a bearing assembly.

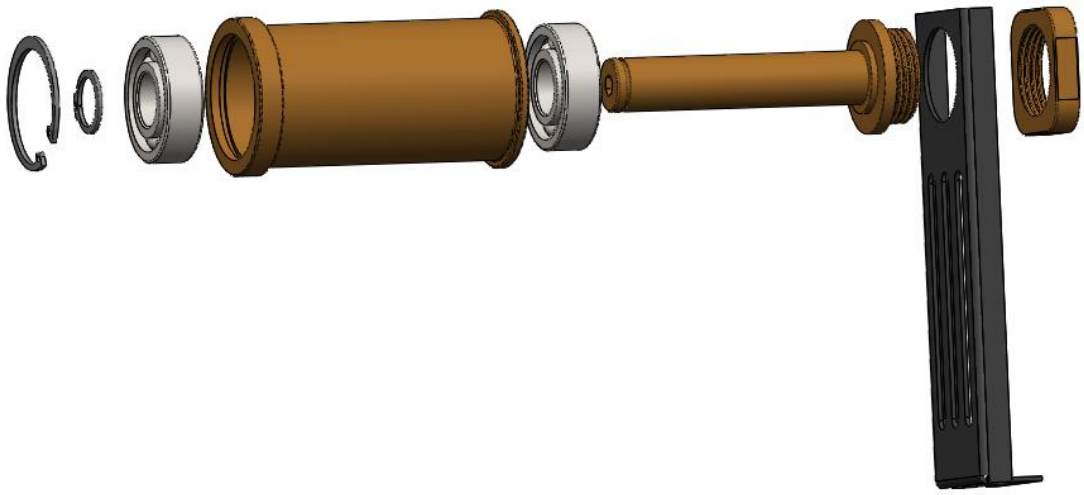

Fig. 7. Roller Holder

The steps described above were followed to make all the printed elements of the final assembly.

Following the printed filament holder, I mounted the original printer holder. It is made of sheet metal and was assembled using 2 M5 screws and 2 T-nuts.

I have developed a new filament roller holder system. To facilitate the filament supply by reducing the stress exerted by the extrusion motor, I decided to use a bearing assembly.

I chose to use two bearings code 6203Z and their securing was done with the help of two Seeger safety rings, respectively 40 mm inner safety and 17 mm outer safety.

In order to facilitate the tightening of the shaft on the sheet metal holder, it is provided with a keyhole with a wrench of 6 mm. The support of the shaft is made with the help of the M30x2 mm thread.

Fig. 8. Shaft and Nut

Making the drum on which the filament roller is mounted:

Fig. 9. Drum

After printing all the component parts, the final assembly was made and its functionality was tested.

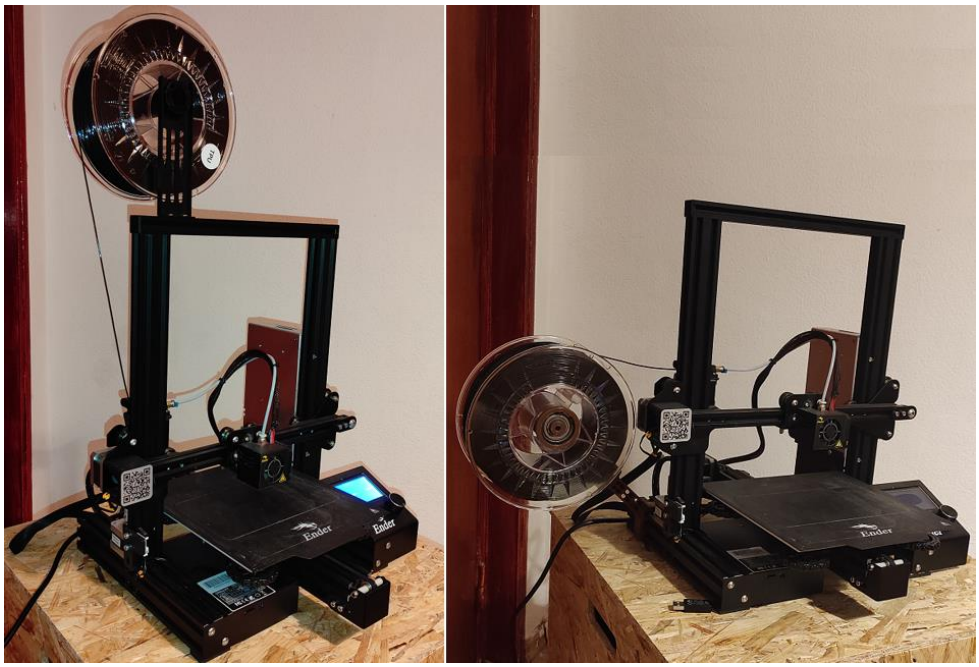

Fig. 10. Standard Holder and New One

5. Conclusions

After one year of use, the filament holder works very well without any deficiencies that affect printing. The only impediment found over time would be that the base holder has twisted which causes the axis of the filament roller to be slightly tilted in the YZ plane of the printer. This aspect can be solved by making the filament holder from a more rigid and durable material such as PETG. Also, when the printer is not in use, the filament roll can be stored separately so that the filament holder is no longer kept under pressure all the time.

Another improvement that I want to make for this printer is a two-roll filament holder that would make it easier to print in two colors on this printer designed by the manufacturer to use a single roll of filament. With such a holder the filament exchange would be done much faster so that the part does not cool during the exchange and the new material adheres much better on the surface of the part. It also reduces the risk of the printer being inadvertently misaligned when changing the filament roll, the main risk being mechanical movement on one of the axes and loss of reference which would lead to resume printing.

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OFFLINE PROGRAMMING OF WELDING ROBOTS

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SUMMARY: Programming robots to perform welding processes is challenging in terms of the requirements for the availability of robotic cells to perform initial tests. In this context, a time and material saving solution is offered by offline programming of robots. The paper presents the possibility of offline programming of welding robots, in particular the programming of a Fanuc robot type ArcMate 100iC, by means of the software solution called "Roboguide". The necessary programming steps will be presented in order to realize the necessary path for circular corner welding of pipe-to-plate components using the "Roboguide" software.

KEYWORDS: welding, industrial robot, programming, offline programming

1. Introduction

1.1. Welding Robots

The expansion of mechanisation and automation of manufacturing processes is one of the most important aspects of the development of manufacturing forces both globally and especially nationally. In the particular case of welding processes, the expansion of mechanisation and automation is the most pressing task facing machine-building companies in the near future.

In the field of robotic welding there are various options for automation and mechanisation of the process. Depending on the proposed application to be realised, there is a multitude of manufacturers offering robotic solutions. These include Fanuc, Kuka and ABB Robotic.

1.1.1. Fanuc

The FANUC ARC MATE 100iBE robot is a robot in modular construction with 6 axes of motion, designed for very high precision. The FANUC ARC MATE 100IBE robot is compatible with all brands of welding equipment and can be programmed point-to-point. It weighs 238 kg. It operates at temperatures between 0°C and 45°C and can withstand a maximum load of 6 kg.

1.1.2. Kuka

The KR 70 R2100 has a streamlined, 6-axis design with greater flexibility; and with a single click you can adjust the movement of the robots to various processes, ease of installation even in compact cells as it has multiple installation modes (floor, angle, wall, ceiling). It has the largest operating range in its class, is suitable for various applications and can be tailored to specific requirements, and presents a low investment for a wide variety of tasks.

1.1.3. ABB Robotics

The IRB 2400 comprises a complete family of application-optimized robots that maximize the efficiency of arc welding, processing and tendering applications. The IRB 2400 is a dedicated high performance robot for process applications where the required accuracies are very demanding. All models offer reverse fit capability. The compact design of the IRB 2400 ensures ease of installation. Robust construction and use of minimal parts contribute to high reliability and long maintenance intervals.

Fig.1. FANUC ARC Mate 100IBE robot (left) and KUKA KR 70 R2100 robot (right)

Fig.2. IRB 2400 Robot

1.2. Offline robot programming possibilities

1.2.1. Roboguide

ROBOGUIDE is a software developed by FANUC to perform most of the operations that can be done on a real robot, but in a virtual environment this offers increased flexibility and overall speed of work as well as a much more efficient possibility to organize activities.

1.2.2. KUKA.Sim

KUKA.Sim is a software developed by KUKA. It creates an identical image of the production process afterwards. The 3D simulation covers the entire planning process: from process design, to visualisation of material flows and bottlenecks, to PLC code. The data is 100% consistent, which means that the virtual and real controllers work with exactly the same data. In this way, KUKA.Sim creates the basis for virtual commissioning, so that new production lines can already be tested and optimised in advance.

1.2.3. Robot Studio

Robot Studio is built on the ABB Virtual Controller, an exact copy of the real software that runs robots in production. This allows very realistic simulations to be carried out using real robot programs and configuration files identical to those used on the shop floor. RobotStudio comes with a complete package of features and add-ons that enable seamless offline simulation, reducing risk, speeding up start-ups, shortening changeovers and ultimately increasing productivity.

2. Offline programming of Fanuc robots

2.1. Roboguide Software

In the ROBOGUIDE program the following types of activities can be done:
- Programming any Fanuc robot model;
- Programming several robots simultaneously;
- Virtual creation of the entire robot cell;
- Import external 3D models as well as existing ones into your own database;
Modelling primitives (cubes, cylinders, etc.) to create secondary models (supports, panels, etc.) ;
- Create additional robot axes;
- Simulation of robot trajectories and operations and of equipment controlled by the robot;
- Automatic creation of trajectories;
- Record simulations to video files.

2.2. Equipment used

2.2.1. 3D model of the components to be joined

The welded sample (Fig. 4) consists of an 8 mm thick plate with dimensions of 400x400 mm and a 10 mm thick square profile with dimensions of 220x220 mm. Both components are made of material S355 JR.

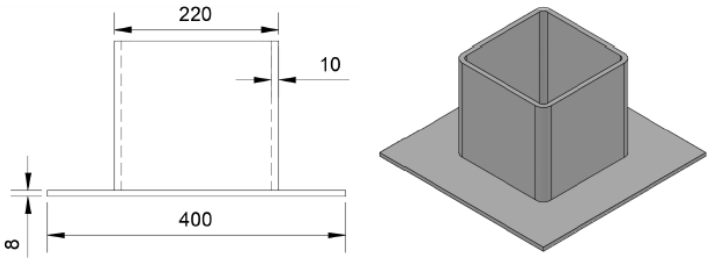

Fig. 3. 3D model of the welded sample

2.2.2. 3D model of the welding robot

The robot used is the FANUC ARC MATE 100iBE, also found in the robotic welding laboratory of the Quality Engineering and Industrial Technologies department.

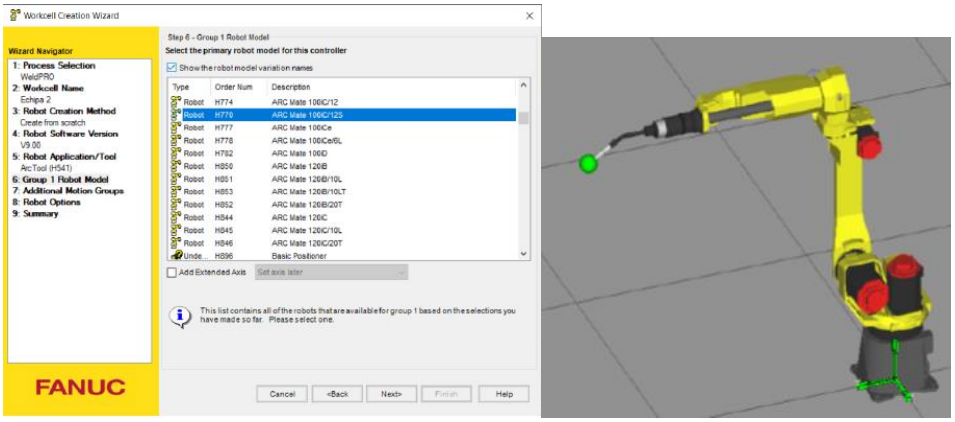

Fig. 4. Robot model selection (left) and 3D model of the ARC MATE 100iBE (right)

2.2.3. Welding torch

In the Arc Tool welding module the welding head was chosen from the software library.

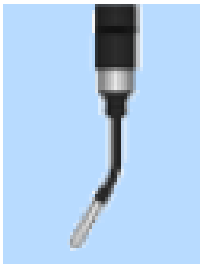

Fig.5. Welding torch used in the "Roboguide" program

2.2.4. Positioning table

The positioning table is chosen by selecting Add Fixture-Single CAD File.

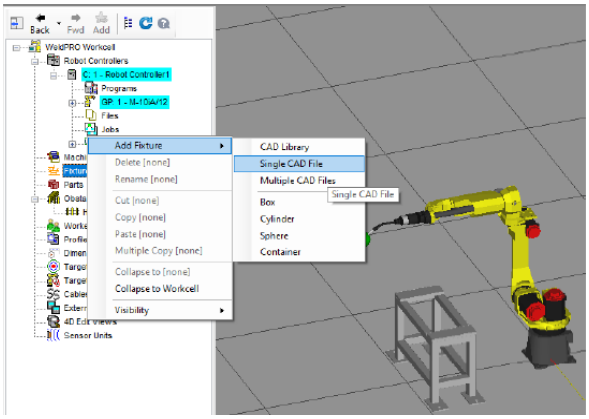

Fig. 6. Welding table in the „Roboguide” program

2.5. Choice of flange type

The "Roboguide" program allows us to choose between several models of flanges, we will choose the one corresponding to our model.

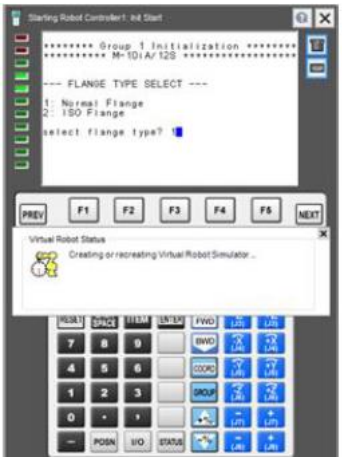

Fig. 7. Flange selection

2.6. Defining coordinate systems

UFRAME represents the coordinate system of the robot, while UTOOL represents the coordinate system of the robot relative to the tip of the welding torch (wire-electrode).

Fig. 8. UFRAME and UTOOL inseration

For the movement of the robot it is necessary to define the coordinate system relative to the welding robot and the work tool (welding head).

When positioned in the welding coordinates the arc start point is defined with the Weld Start command. Depending on the length and complexity of the weld bead new intermediate welding points can be defined by calling the Weld point command. The end of the weld bead is defined with the WeldEnd command. Moving the robot between intermediate points can be done with the remote control shown in the bottom right corner of fig 9.

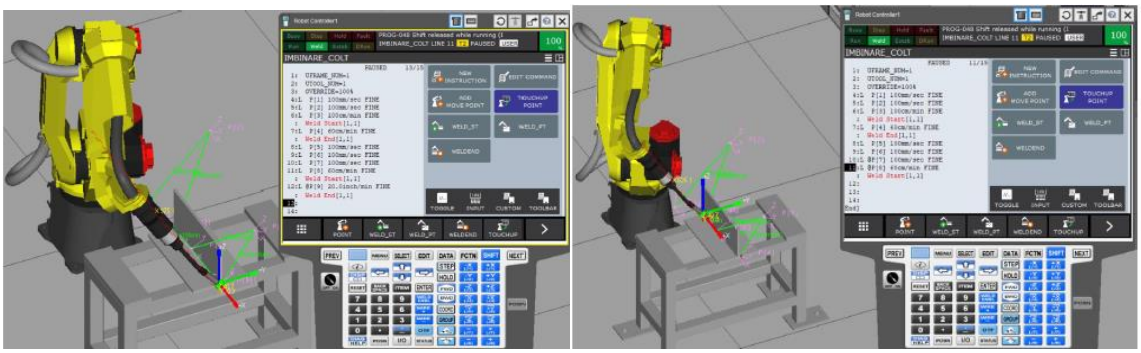

Fig. 9. Memorarea punctelor de început și finale de sudură

3. Conclusions

This paper presents the possibility of offline programming of welding robots. Offline programming offers a number of advantages such as:

-time savings through simulations in a virtual environment;
-economy of materials;
-reduced work cell load;
-in the context of recent restrictions, programming can be done from anywhere;
-without requiring direct interaction with the robot in the production hall;
-developing the new concept of Industry 4.0.

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PROCESS MANAGEMENT EVALUATION USING THE EFQM MODEL

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SUMMARY: The paper presents the Evaluation of process management based on the EFQM model for the company Glorious Lighting SRL from Braila. According to the scores obtained, a radar chart is made which shows that it has leadership problems.

At the end it is specified that an application will be made that will improve this part in half a year, through a telephone message that reminds on the first Monday of each month, what is the flow of the process in each department and when it is a new process or a modified one, will send a notification with that information on that day.

Keywords: EFQM, application, leadership

1. Introduction

The study aims to identify based on the EFQM model and the actual evaluation of the management in order to improve the practices of transfer to the company and to identify areas with potential for improvement with the help of the radar chart..

Table 1. EFQM

	Factors																						Results							
Criterion	Leadership					Strategy				People					Partnerships & Resources					Process, Products and Services					Customer results		People results		Society results		Key Results	
Criterion part	A	B	C	D	E	A	B	C	D	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	A	B	A	B	A	B
Achieving balanced results		X	X			X		X	X							X	x		X						X	X	X	X	X	X	X	X
Adding value for customer			X				X														X	X	X	X	X	X		x				
Leading with vision, inspiration and integrity	X			X				X					X														X		X			X
Managing by process		X					x		X			X				X	x	x	X	X		x				X		x		x		X
Succeeding through people	X			X					X	X	X	X	x	X													X	X	x			
Nurturing creativity & innovation			X				x		X			X						X	X	X	X				x	X	x	X	x	X	x	X
Building partnerships			X			x	x								X							x			x	X	x	X	x	X	x	X
Taking responsibility	X	X	X		X	x	x	X					X	X			X				x		X	x			x		X	X	x	

for a sustainable future																														

X – Text from fundamental concept directly reflected in the criteria part
x – Adaptation of text from fundamental concept appears in the criterion part

2. Process management assessment

At this time, management does not announce when a change in the flow of departments is changing, and most of the time employees do not know the flow of the department they belong to.

1. ***Leadership*** - Excellent Leaders develop and facilitate the achievement of the mission and vision. They develop organizational values and systems required for sustainable success and implement these via their actions and behaviors. During periods of change they retain a constancy of purpose. Where required, such leaders are able to change the direction of the organization and inspire others to follow.
1. b. Leaders are personally involved in ensuring the organisation's management system is developed, implemented and continuously improved.
   This may include:

- Aligning the organisation's structure to support delivery of its policy and strategy; (1)
- Ensuring a system for managing processes is developed and implemented; (2)
- Establishing clear ownership of processes; (3)
- Ensuring a process for the development, deployment and updating of policy and strategy is developed and implemented; (4)
- Ensuring a process for the effective governance of the organisation is developed and implemented; (5)
- Ensuring a process for the measurement, review and improvement of key results is developed and implemented; (6)
- Ensuring a process, or processes, for stimulating, identifying , planning and implementing improvements to enabling approaches e.g. through creativity, innovation and learning activities, is developed and implemented. (7)

1b. Strengths

- Leaders are helping each other with all the information so the organization's structure to support delivery of its policy and strategy. (1) – 65%
- Company has implemented the ISO 9001:2015 and the leaders have developed and implemented management system work procedures. (2) – 75%
- Leaders help employees in their free time at work so they can be happy and the job can be easier most of the time at work.(3) – 60%
- When the time is enough, leaders are teaching the employees the no how method, they do some trainings to evolve the team and some nice application so the team can learn and do something fun.(7) – 75%

1b. Areas for Improvement

- After the certification ISO 9001 was done, the leaders don't update anymore in real time the working procedures. (4) – 35%

- The flow of the organization is not respected all the time by leaders and sometimes the flow is changed and no annonce is done. (5) – 25%
- Leaders don't have developed and implemented a process for the measurement, review and improvement of key results. They have in the inbox of e-mail the reviews. (6) – 10%

2. ***Policy and Strategy*** - Excellent Organizations implement their mission and vision by developing a stakeholder focused strategy that takes account of the market and sector in which it operates. Policies, plans, objectives, and processes are developed and deployed to deliver the strategy.

2. d. Policy and Strategy are communicated and deployed through a framework of key processes.

This may include:

- Identifying and designing and communicating the framework of key processes needed to deliver the organization's policy and strategy; (1)
- Communicating policy and strategy to stakeholders and evaluating the awareness of it; (2)
- Aligning, prioritizing, agreeing, cascading and communicating plans, objectives and targets as well as following up achievements; (3)
- Establishing organization wide reporting mechanisms to track progress (4)

2d. Strengths

- Employees are informed about the policy and strategy of the organization from the first days. (1) – 90%
- Policy and strategy of the organization is communicated via telephone or e-mail to stakeholders, but sometimes the company is missing evaluating the awareness of it (2) – 55%
- Top managemant analize the plans and necessary things that the employees from company should do and give the information trow away to leaders. From there, the leaders are prioritizing the objective and targets and share the responsibilities of the team, after which they follow the results. (3) - 95%
- Top management and leaders have different ways to track the process, such as: an excel with the day-to-day action plan, from the email that employees send that day, last week's results, and so on. (4) – 85%

3. ***People*** - Excellent organizations manage, develop and release the full potential of their people at an individual, team-based and organizational level. They promote fairness and equality and involve and empower their people. They care for, communicate, reward and recognize, in a way that motivates staff and builds commitment to using their skills and knowledge for the benefit of the organization.

3. c. People are involved and empowered.

This may include:

- Encouraging and supporting individual and team participation in improvement activities; (1)
- Encouraging and supporting people's involvement e.g. through in-house conferences, ceremonies and community projects; (2)
- Providing opportunities that stimulate involvement and support innovative and creative behavior; (3)
- Training managers to develop and implement guidelines empowering people to take action; (4)
- Encouraging people to work together in teams.(5)

3c. Strengths

- When the samples are painted people that are involved have to stay with the painters and observe the whole process they go through and if they encounter problems will try another option for optimal results. (1) – 95%
- People are involvement weekly in-house conferences with others departments and they discuss about what it's new and what everyone has to do. (2) – 90%
- The best example of stimulating involvement and supporting innovative and creative behavior is the situation where I needed to do some tests that will eliminate some additional costs in mass production and I implemented it with the help of the team. (3) – 95%
- When a team have a task, the coordinator encouraging people to collaborate and help each other for things to go smoothly. (5) – 80%

3c. Areas for Improvement

- Sometimes managers have some trainings regarding developed and implemented guidelines empowering people to take actions (4) – 20%

4. ***Partnerships and Resources*** - Excellent organizations plan and manage external partnerships, suppliers and internal resources in order to support policy and strategy and the effective operation of processes. During planning and whilst managing partnerships and resources they balance the current and future needs of the organization, the community and the environment.

4. b. Finances and managed

This may include:

- Developing and implementing financial strategies and processes for using financial resources in support of overall policy and strategy. (1)
- Designing the financial planning and reporting to cascade the financial stakeholders expectations throughout the organization. (2)
- Establishing reporting mechanisms (3)
- Evaluating investment in and divestment of both tangible and non-tangible assets (4)
- Using financial mechanisms and parameters to ensure an efficient and effective resourcing structure (5)
- Developing and introducing methodologies for managing risks to financial resources to all appropriate levels in the organization (6)
- Establishing and implementing core governance processes at all appropriate levels in the organization. (7)

4b. Strengths

- With help of the cash flow that is do it weekly, the developed and implemented financial strategies and processes are used in support of overall policy and strategy. (1) – 80%
- Purchasing team give an approximate cash flow to the suppliers. (2) – 85%
- Mechanisms of reporting is by e-mail of at phone calls. (3) – 85%
- Financial department use tables in excel in order to ensure an efficient and effective resourcing structure. (5) – 90%

4b. Areas for Improvement

- In this moment company don't evaluate investment in and divestment of both tangible and non-tangible assets. (4) – 0%
- Developing and introducing methodologies for managing risks to financial resources to all appropriate levels in the organization is not respected all the time. – 15%
- In this moment in company we don't establishing and implementing core governance processes at all appropriate levels in the organization. – 0%

4. d. Technology is managed

This may include:

- Developing a strategy for managing technology that supports the organizations policy and strategy; (1)
- Identifying and evaluating alternative and emerging technologies in the light of their impact on business and the society; (2)
- Managing the technology portfolio including the identification and replacement of outdated technology; (3)
- Exploiting existing technology; (4)
- Developing innovative and environmentally friendly technology (i.n. conserving energy and resources, minimization of waste and emissions, encouraging recycling and re-use); (5)
- Using Information and Communication Technologies to support and improve the effective operation of the organization; (6)
- Using technology to support improvement. (7)

4d. Strengths

- The company buyed automatic machines like conveyors and automation packaging machine in order to satisfy the organizations policy and strategy (1) – 80%
- Company manage the technology, within the allocated budget, they bring sometimes high-performance machines to make work easier. (3) – 80%
- The current technology is exploited as the painting lines when the staff is enough the conveyor goes at a much higher speed. (4) – 70%
- Company encouraging recycling with help from the client (the bags are a percentage recicled), R&D department are in develop with the concrete base instead of EVA base, Quality team do evaluate the components and give it to rework if it is possible. (5) – 95%
- Company use the technology to support improvement such as the automatic packaging machine is better on the pallet that the normal packing with straps because is not damaging the extern packing. (7) – 80%

4d. Areas for Improvement

- The company does not identify and evaluate alternative and emerging technologies in light of their impact on business and society, for example, we do not have a generator for light in production lines. (2) – 10%
- At the metal process they use information and communication technologies to improve the problems we regard like the spinning marks. (6) – 25%

4. e. Information and Knowledge are managed

This may include:

- Developing a strategy for managing information and knowledge that supports the organisations policy and strategy; (1)
- Identifying the organisations information and knowledge requirements; (2)
- Collecting, structuring and managing information and knowledge in support of policy and strategy; (3)
- Providing appropriate access, for both internal and external users, to relevant information and knowledge; (4)
- Using information technology to support internal communication and information and knowledge management; (5)
- Assuring and improving information validity, integrity and security; (6)
- Cultivating, developing and protecting unique intellectual property in order to maximise customer value; (7)
- Seeking to acquire, increase and use knowledge effectively; (8)
- Generating innovative and creative thinking within the organisation through the use of relevant information and knowledge resources. (9)

4e. Strengths

- Organisations information and knowledge requirements are specified from first days and are different from one department to another. (2) – 75%
- According with ISO 9001 company have collected, structured and managed information and knowledge in support of policy and strategy in procedures. (3) – 60%
- Some of the informations are provided at reception in the company, to be visible for internal and external users and the rest for the information that are necessary for provided to the internal user at needed time. (4) – 55%
- Departments use the email and the application WeChat to support internal communication and information and knowledge management. (5) – 95%
- Once of week the IT company ensures and improves the validity, integrity and security of information. (6) – 80%
- In the weekly meetings all the involved department comes with ideas in cultivating, developing and protecting unique intellectual property in order to maximise customer value. (8) – 80%
- The relevant information and knowledge resources are getting from different types of standards trying to generating innovative and creative thinking. (9) – 75%

4. e. Areas for Improvement

- In this moment, the company don’t have a strategy for managing information and knowledge that supports the organisations policy and strategy. (1) – 0%
- Company don’t progress with cultivating, developing and protecting unique intellectual property in order to maximise customer value. (7) - 0%

5. ***Processes*** - Excellent organizations design, manage and improve processes in order to fully satisfy, and generate increasing value for, customers and other stakeholders.
5. a. Processes are systematically designed and managed

This may include:

- Designing the organization's processes, including those key processes needed to deliver policy and strategy; (1)
- Identifying process stakeholders and managing interface issues inside the organization and with external partners for the effective management of end-to-end processes; (2)
- Establishing the process management system; (3)
- Applying systems standards covering, for example, quality management systems, environmental systems, occupational health and safety systems in process management; (4)
- Implementing process indicators and setting performance targets; (5)
- Reviewing the effectiveness of the process framework in delivering the organizations policy and strategy. (6)

5a. Strengths

- In conformity with the working procedures and system for ISO 9001, company have designed the organizationțs processes, including those key processes needed to delivery policy and strategy. (1) – 100%
- Organization identify process stakeholders and for all the issues inside the organization they find a solution internal to can solve the problem and with external partners it do the deviations for issues that it found and send it to the suppliers so can appears again. (2) – 90%
- The process management system will be found in working procedures that all the departments implemented it for standard ISO 9001. (3) – 75%
- All the system standards are applied in company with help of necessary departments. (4) – 90%

5a. Areas for Improvement

- Implementing process indicators was done in the procedures for ISO 9001, but the company doesn't set a performance targets. (5) – 45%
- In most of the time, the company doesn't review the effectiveness of the process framework in delivering the organizations policy and strategy. (6) – 20%

6. ***Customer Results*** - Excellent organizations comprehensively measure and achieve outstanding results with respect to their customers.
6. b. Performance Indicators

These measures are the internal ones used by the organisation in order to monitor, understand, predict and improve the performance of the organisation and to predict perceptions of its external customers.
Depending on the purpose of the organisation examples of measures that may be made, include:
• image (1) : number of customer accolades and nominations for awards; press coverage.
• sales and after sales support (2) : demand for training; handling of complaints; response rate.
• product and services (3) : competitiveness; defect, error and rejection rates; seals of approval, environmental labels; guarantee provisions and warranty provisions; complaints; logistic indicators; product life cycle; innovation in design; time to market;
• loyalty (4) : duration of relationship; effective recommendations; frequency/value of orders; lifetime value; numbers of complaints and compliments; new and/or lost business; customer retention.
6b. Strengths

- The sales and after sales support are supported like: the involved departments have regulated trainings with the client, all the complaints are solved by the quality department and all the time the client recive a respond from our involved departments.(2) – 100%
- The products from company is: competitiveness because we give one of the lowest price, the defects, errors, rejection rates and also complaints are few, the quality department has the best KPI compared to the other suppliers of our client, all the articles have seals of approval have environmental labels, time to market is shorter because we have a lot of suppliers and also the product life cycle is better than another suppliers. (3) – 75%
- The company is one of the best suppliers for our customer at loyalty because: we collaborate and keep the retention with customer from more than 3 years, we have the products ready for delivery in a high frequency of orders, we have low numbers of complaints and the R&D department develop new products any time when is required. (4) – 80%

6b. Areas for Improvement

- The image, including the number of customer accolades and nominations for awards and press coverage are not applied in the company , one of the reason probably is that the company have just one client. (1) – 10%

9. ***Key Performance Results*** **-** Excellent organizations comprehensively measure and achieve outstanding results with respect to the key elements of their policy and strategy.

9. b. Key Performance Indicators

These measures are the operational ones used in order to monitor and understand the processes and predict and improve the organization's likely key performance outcomes.
Depending on the purpose of the organization examples of measures that may be made include:

- Financial (1): Cash flow; Depreciation; Maintenance costs; Project costs; Credit ratings
- Non-Financial (2): Processes (performance; assessments; innovations; cycle times); External resources including partnerships (supplier performance; supplier price; number and value added of partnerships; number and value added of joint improvements with partners); Buildings, equipment and materials: (defect rates; inventory turnover; utilization); Technology: (innovation rate; value of intellectual property; patents; royalties); Information and knowledge: (accessibility; integrity; value of intellectual capital).

9b. Strengths

- The financial part do the cash flow weekly, the maintenance costs twice a month and the project costs every time a part of our product increase or when a new product appear. (1) – 75%
- The production measure the cycle times and management do the assessments annually, purchasing team evaluate the performance of the supplier and add the supplier price in ERP, maintenance department register the defect rates of equipment and the production help with the utilization of materials. – 55%

3. Discussion and Radar analyis

I learned to apply a structured model that allows me to see in correlation the strengths and areas for improvement in the company. Improvement projects are structured and prioritized from the identified areas for improvement.

Table 2. Radar chart

No.	1b	2d	3c	4a	4d	4e	5a	6b	9b
Percentage	49.28%	81.25%	76%	50.71%	62.85%	57.77%	70%	66.25%*1.5	65%*1.5
Score	49	81	76	51	63	58	70	99	97.5

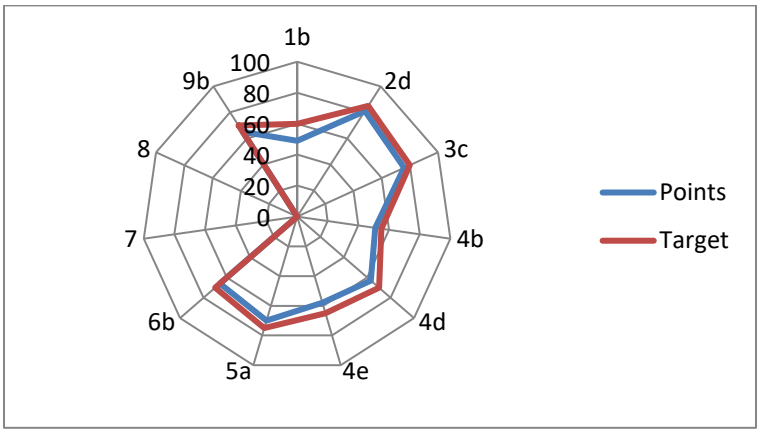

Figure 1. Radar chart

4. Conclusion

The area where there is maximum potential for improvement in conformity with radar graphic is „Leadership". In half year the company intends to reach 60 points on the 1b line with the implementation of an application that will remind with a message by phone, on the first Monday of each month, what is the flow of the process of each department and when is new or changed process, the application will give a notification with this information in that day.

The selfassessment will be relaunched after the improvement project implementation to assess the effectiveness. Positive results are expected based on the preliminary implementation.

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ONLINE PROGRAMMING POSSIBILITIES FOR WELDING ROBOTS

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SUMMARY: The paper presents the possibility of online programming of welding robots, in particular the programming of a Fanuc robot type ArcMate 100iC, making 6 different samples to highlight the differences between them at different values and parameters. The necessary steps of programming in order to make the welded joint will be presented.

KEYWORDS: industrial robot, welding

1. Introduction

Welding is a technological process of joining two or more parts together in a non-detachable manner by means of a welding process, in such a way as to obtain a metallic connection of equal strength, which is safe in execution and operation. [1]

1.1 ROBOTIC WELDING.

The word robot originates from the Czech word "robota" which means work. According to the definition in the encyclopaedic dictionary, it is an automatic machine whose program contains a complex system with inverse links (reaction) established to certain external signals, being capable of directed and controlled actions. [2]

Welding robots are generally referred to as fully automated systems for performing welding operations with the possibility of programming.

The main tasks pursued by robotics are the removal of a person from the welding area, the complete automation of production, and hence the increase in productivity. [3]

1.2 MIG/MAG WELDING

The MIG/MAG welding process is one of the most popular welding processes. The process also has the highest utilisation rate. It is used in several fields: [4]

- Machine building industry;
- Metal fabrication;
- Shipyards;
- Welding of gas mains;
- Car workshops for repairs (paintwork, exhaust pipes, etc.);
- Bicycle manufacturing;
- Repairs;
- Welding of weldments.

MIG/MAG welding is an electric arc welding process in a shielded gas environment with a fusible electrode. The shielding gas has the function of protecting the molten metal bath from the unwanted actions of oxygen and nitrogen in the atmosphere. [4]

- MIG (Metal Inert Gas) - examples of inert gases: argon, helium or mixtures of these gases, and are used to weld aluminium, copper, titanium or magnesium parts.

- MAG (Metal Active Gas) the shielding gas used is carbon dioxide or mixtures of this gas with argon. Active gases are used to weld ordinary, construction or high-alloy steels.

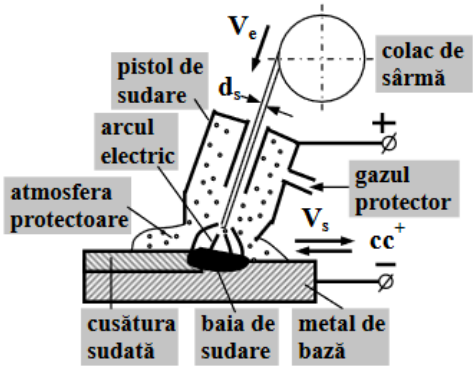

FIG. 1.2.1. MIG/MAG PRINCIPLE DIAGRAM [5]

Advantages of the MIG/MAG welding process: [4]

- It has a high degree of universality;
- Welding of all materials;
- Possibility of automation or robotization depending on the application;
- High deposition rate;
- High productivity;
- Obtaining very high quality joints;
- Low smoke emissions;
- Possibility of welding in any position.

Disadvantages of the MIG/MAG welding process: [4]

- Larger and more expensive welding equipment;
- Loss of filler material through spatter;
- Sensitive to air currents (avoid welding in open space);

1.3. PURPOSE OF THE WORK

The purpose of the work is to observe the differences between joints welded under different conditions.

In order to observe the possible differences, 6 tests with different parameters were performed, namely: welding at 30, 45 and 60 with intensity I = 260 A, welding at 45 and intensity I = 160 A, and two push-pull tests at 45 and 15 with respect to the feed direction.

2. MATERIALS AND METHODS

2.1. EQUIPMENT USED

For the practical part of the work, the FANUC ARC 100iBe robot and the FRONIUS TSP 4000 source were used as equipment.

FIG. 2.1.1. FANUC ARC 100iBe [6]

FIG. 2.1.2. FRONIUS TSP 4000 [7]

Robot specifications:

Axis	6
Payload	6 kg
Repeatability	± 0,08 mm
Robot mass	238 kg
Structure	Articulated
Floor mounting	

Source specifications:

Mains voltage	3 x 400 V
Mains voltage tolerance	+/- 15%
Mains frequency	50/60 Hz
Mains safety	35 A slow
Continuous current in primary circuit	(100% DA) 26 A
Efficiency 88% Efficiency	
MIG/MAG welding current range:	3 - 400 A

2.2 MATERIAL

The materials used were:
- Basic material: S275JR
- Additive material: G3Si2

TABLE 2.2.1. CHEMICAL COMPOSITION S275JR [8]

C	Mn	P	S	N	Cu

max 0.22	max 1.5	max 0.04	max 0.04	max 0.012	max 0.55

TABLE 2.2.2. CHEMICAL COMPOSITION G3Si2 [9]

C	SI	MN	CR	NI	S
0,06-0,14	0,7-1	1,3-1,6	≤0,15	≤ 0,15	≤ 0,025

2.3 EXPERIMENTAL DATA

For the practical work, 12 pieces of S275JR steel plate were used with dimensions: width 9 mm and length 24 mm with thickness 6 mm.
They were placed in "T" profiles and welded in wells at the ends by the SMEI (Manual Welding with Coated Electrode) process to provide support.
After welding was completed, slag was removed by successive hammer blows and the surface was cleaned with a wire brush.

FIG. 2.3.1. POSITIONING OF TABLES

FIG. 2.3.2. FIXING PARTS BY SPOT WELDING

FIG. 2.3.3. REMOVING SLAG WITH A HAMMER

FIG. 2.3.4. CLEANING THE SURFACE WITH A WIRE BRUSH

The 6 problems were moved into the robotic cell to be MIG welded, using G3Si2 as filler material and Ar+18%CO2 as shielding gas.

The parameters used were:

SAMPLE 1: I = 180 A
U = 18.5 V
Vane = 4.4 m/min

SAMPLE 2-6: I = 260 A
U = 26.2 V
Vas = 8,1 m/min

2.4. RESULTS

Following robotic welding, the following were obtained:

TEST 1: Welding was carried out at an angle of 45° with intensity I = 180 A.

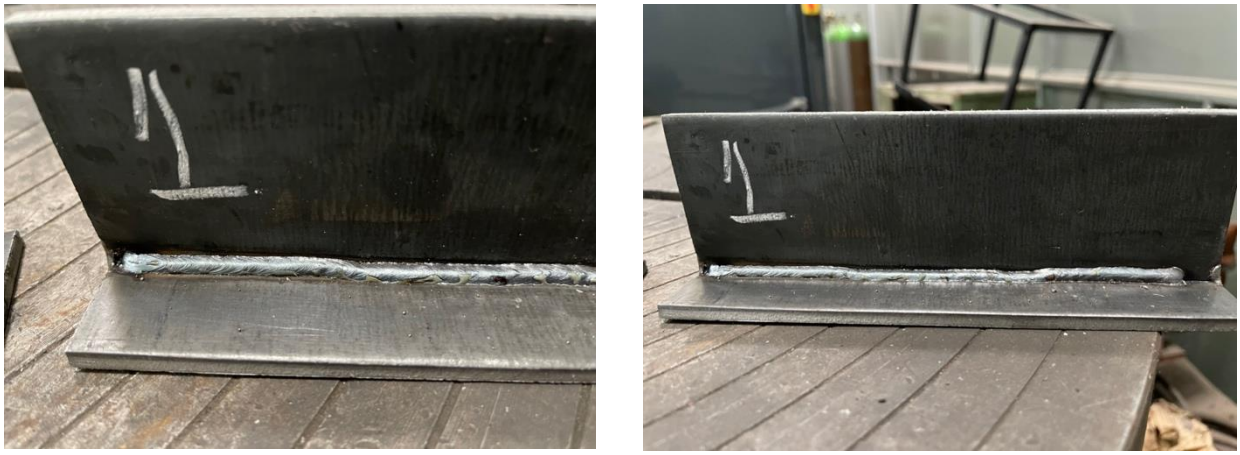

FIG. 2.4.1. WELDED JOINT SAMPLE 1

TEST 2: Welding was carried out at an angle of 45° with intensity I = 260 A.

FIG. 2.4.2. WELDED JOINT SAMPLE 2

TEST 3: Welding was carried out at an angle of 60° with intensity I = 260 A.

FIG. 2.4.3. WELDED JOINT SAMPLE 3

TEST 4: Welding was carried out at an angle of 30° with intensity I = 260 A.

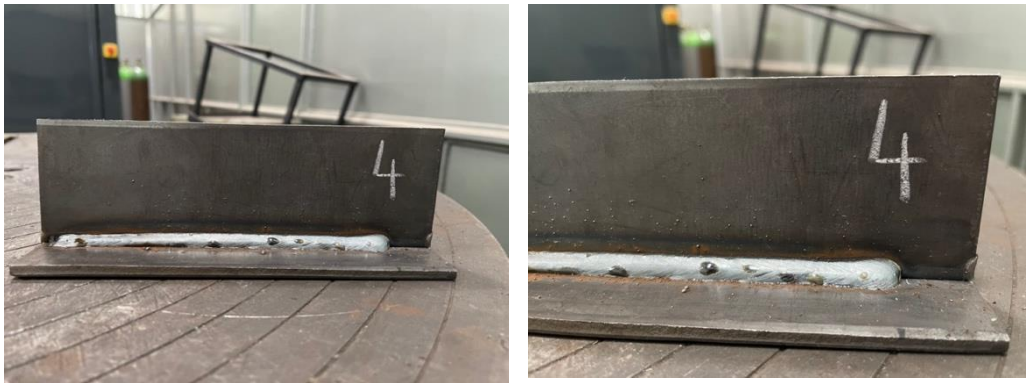

FIG. 2.4.4. WELDED JOINT SAMPLE 4

TEST 5: Welding was carried out at an angle of 45° with intensity I = 260 A.
Pushed at an angle of -15° to the direction of travel of the gun.

FIG. 2.4.5. WELDED JOINT SAMPLE 5

TEST 6: Welding was carried out at an angle of 45° with intensity I = 260 A.
Firing at an angle of 15° to the direction of travel of the gun.

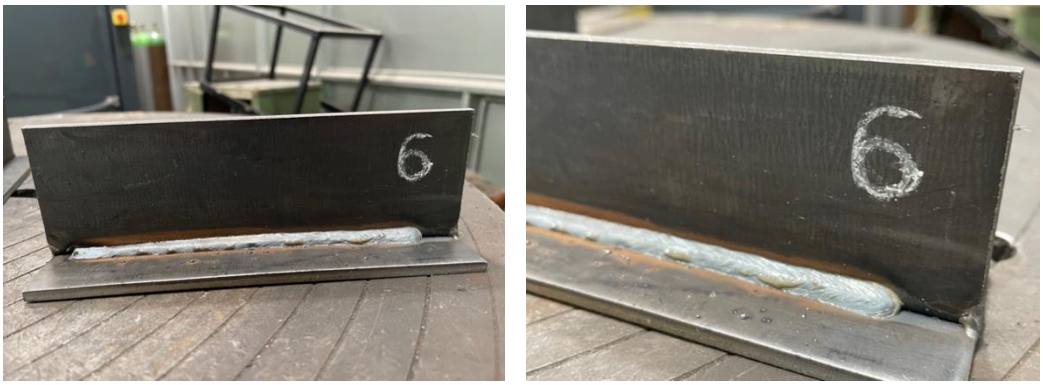

FIG. 2.4.6. WELDED JOINT SAMPLE 6

In the first test the intensity value was low, which led to an inadequate deposition in terms of the geometrical characteristics of the weld bead.
The position of the welding head was corrected and the intensity was modified in order to increase this value, which resulted in a bead with satisfactory geometrical characteristics.

3. CONCLUSIONS

The online programming and testing of the welding technology gives us the possibility to effectively visualize the obtained ropes and to make possible corrections caused by the incorrect choice of welding parameters.

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GEOMETRIC MODELING OF PARTS USING SOLIDWORKS AND CATIA APLLICATIONS

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ABSTRACT: In the presence of the scientific paper we want to highlight the design of two different parts crankshaft, respectively 3D support frame using two different design programs CATIA and SolidWorks.
The crankshaft transmits the rotational to the connecting rod, as part of an engine assembly. Crankshafts are dimensioned according to the power developed by the engine which define the loads to which it is subjected.
Regarding the support designed in SolidWorks we remind you that the three-dimensional sketches consist of successive lines and arcs as well as three-dimensional spline curves, and in the following presentation we will use an artifice to design the piece.

KEYWORDS: geometric modeling, CATIA, SolidWorks.

1. Introduction

CATIA (Computer Aided Three-dimensional Interactive Application) is a CAD/CAM/CAE cross-platform commercial software suite developed by the French company Dassault Systems and marketed worldwide by IBM. CATIA supports several stages of product development, from conceptions, design (CAD), manufacturing (CAM) and analysis (CAE). It is widely used throughout the industry, especially in the automotive and aerospace sectors.

SolidWorks is a highly productive 3D CAD software tool with integrated analytical tools and design automation to help stimulate physical behavior such as kinematics, deviation, dynamics, vibration, temperature or fluid flow to suit all types of design. This 3D modeling CAD software is widely used in the mechanical engineering and design industry. It is the industry standard for product development.

The aim is to provide an image of the generation of different parts treated in two distinct design programs by various methods. The version of the program used is 2016 – for SolidWorks and for CATIA V5.

2. Modeling a crankshaft

The first step is to create a new “Part” file in the CATIA V5 software (Figure 1).

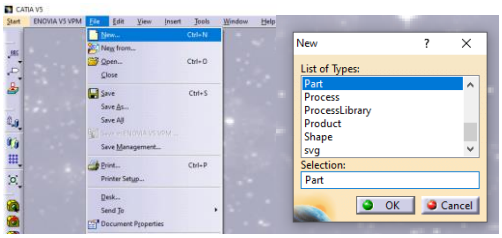

Fig. 1. Creating a new file

A sketch (Figure 2) was created in the ZX plan (Figure 3) to begin modeling the crankshaft.

Fig. 2. Creating a sketch

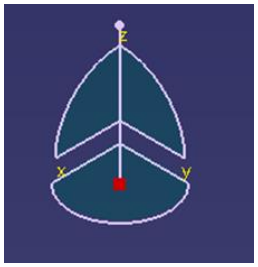

Fig. 3. Choosing the plane ZX

We made the crankpin journal using the “Circle” command from the command manager (Fig. 4).

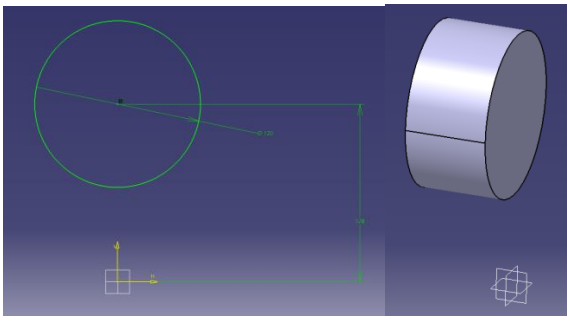

Fig. 4. Creating a crankpin journal

The next model was a shoulder for centering the crank in the crankshaft system using the bearing of the previously made bearing spindle as a support using the same command as the top “Circle“ (Fig. 5).

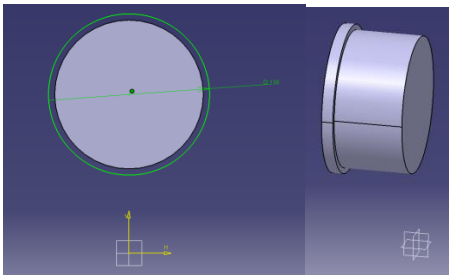

Fig. 5. Creating a shoulder

We made the “turns” profile using the face of the previously shaped shoulder as a sketch support (Figure 6).

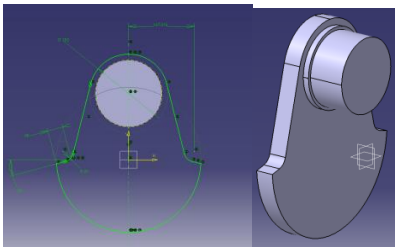

Fig. 6. Creating a turning profile

The next thing to do for the model is the shoulder for the crankpin journal using the front turn as a support (Figure 7). Next the spindle bearing was made (Figure 8).

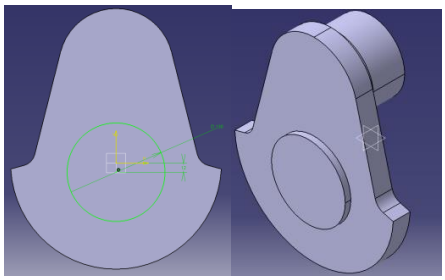

Fig. 7. Creating a shoulder

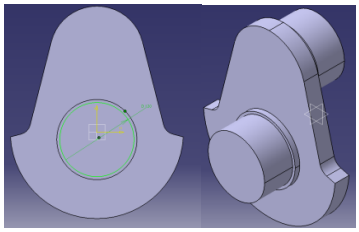

Fig. 8. Creating a spindle bearing as main journal

Next we made the other shoulder of the spindle bearing using the “Circle” command (Figure 9), following the other turn (Figure 10).

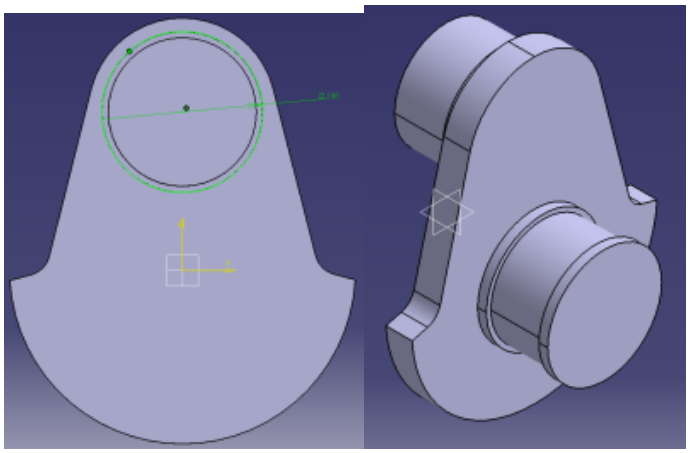

Fig. 9. Creating the other shoulder of the spindle bearing

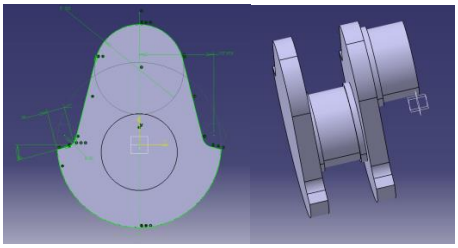

Fig. 10. Creating the other turning

The rest of the crankshaft was made in the same way as presented above. Finally, a crankshaft was made that can be used on 4 cylinder engines with 4 crankpins journal (Figure 11).

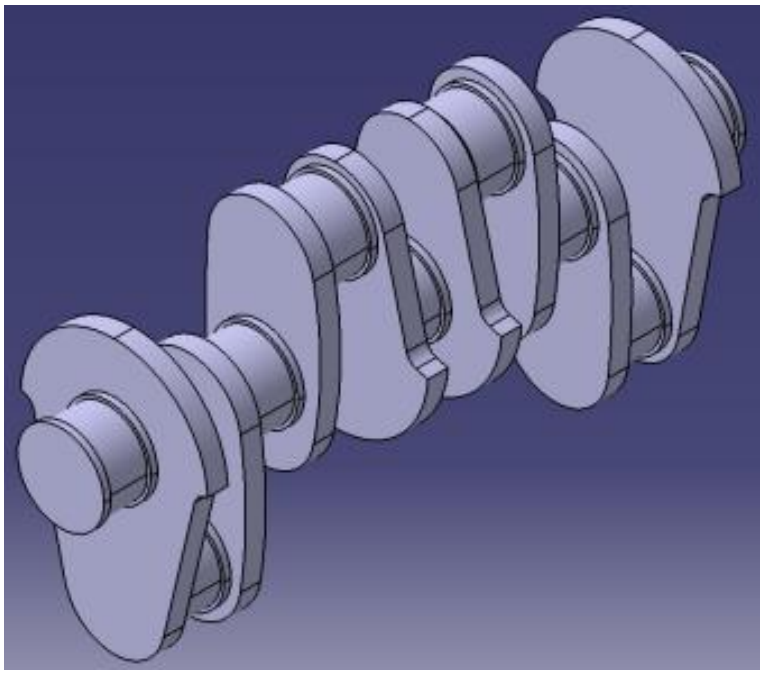

Fig. 11. The crankshaft

We have exemplified below what are the spindle bearings and crankpins, the spindle bearings hold the crankshaft and they are alined forming the spining axis, and the crankpins are the bearing supports on which the connecting rods are mounted (Figure 12).

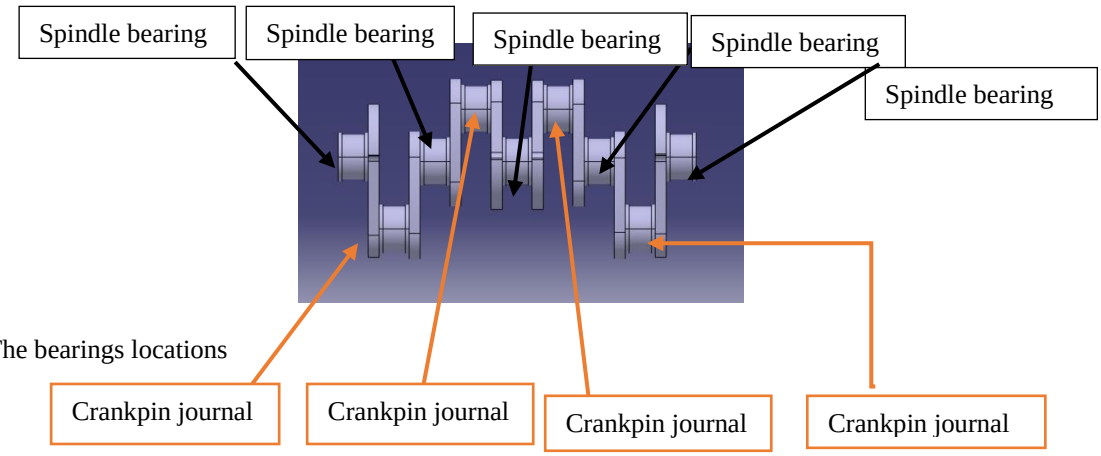

Fig. 12. The bearings locations

3. Modeling a 3D support frame

The first step is to create a new “Part” file in the SolidWorks software (Figure 13) in which we will select 3D Sketch (Figure 14).

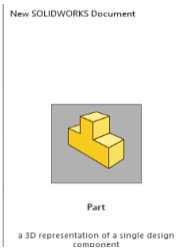

Fig. 13. Creating a new file

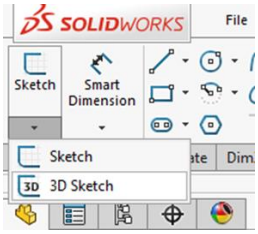

Fig. 14. Selecting a 3D Sketch type

We start by drawing first the right half of the piece drawing a line using the Line function on the OX axis starting from the beginning in the XY plane (Figure 15) a segment that we will quote in the properties window of this line in Parameters box.

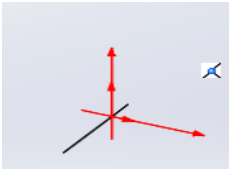

Fig. 15. Choosing the plane XY

We will continue sketching a segment in the YZ plane (Figure 16) moving the cursor over the right end and of the already drawn segment at which point we simultaneously press TAB + the left button to move to the YZ drawing plane. The newly appeared segment will be listed in the Line Properties -> Parameters box window.

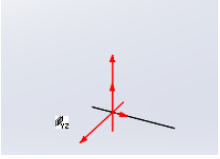

Fig. 16. Choosing the plane YZ

Once all the segments that make up the frame have been sketched we will move on to the next stage namely the 5 connections, successively selecting the lines that form each intersection in the sketch using the Sketch Fillet function from the Sketch Bar (Figure 17).

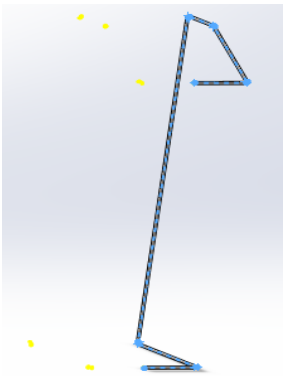

Fig. 17. The connections

The first half of the model will be made by drawing a circle along the 3D Sketch (Sweep) so the right plane and the Sketch button will be selected to open a new sketch. We will use the Zoom to Area function, enlarging the area that comprise the first segment the one at the top of the dragging and select Circle to draw a circle with the center at the left end of the segment (Figure 18). Exit sketch and return to the command manager to Features button frum where we will select Sweep thereby appearing a new Sketch under the name Sketch 1 which will be found in the text box corresponding to the profile.

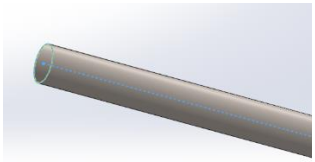

Fig. 18. The circle at the end of the segment

To finish the piece we mirror the pattern in relation to the circular face: Insert -> Pattern -> Mirror by clicking on the upper circular face, followed by clicking anywhere on the frame (Figure 19).

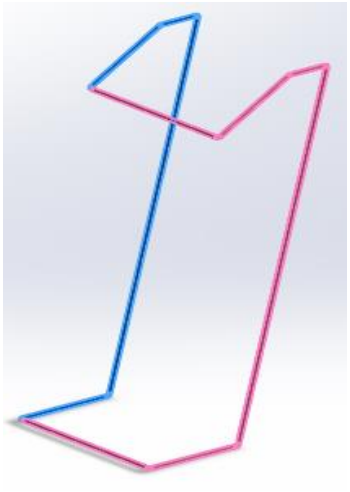

Fig. 19. The mirror pattern

The last step is to choose the material, in our case using Alloy Steel. The 3D support frame is completed and its shape can be found in Figure 20.

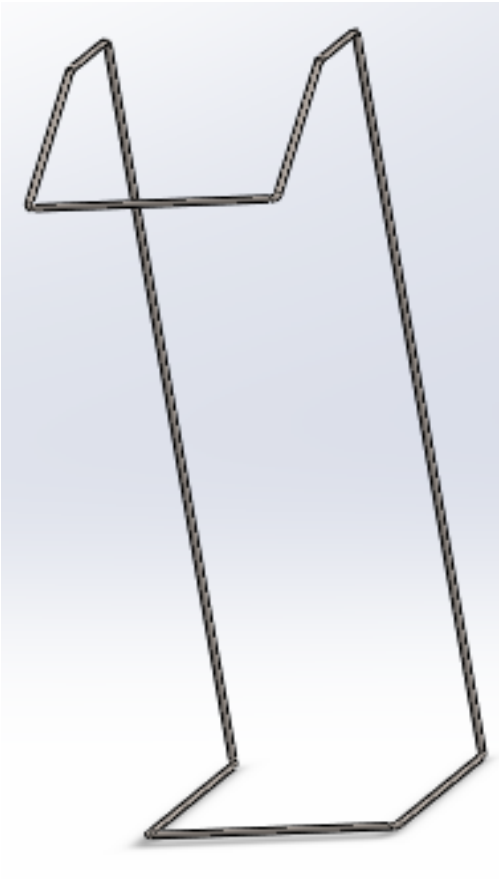

Fig. 20. The 3D support frame

4. Conclusions

The contribution of the team that lead to the elaboration of this scientific paper consists in the design of two pieces frequently used in daily life through different procedures and software suites approaching the calculation of quotas for their finalization in the most efficient and feasible way.

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PLASTIC RECYCLING

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ABSTRACT: Plastic pollution can also contaminate the air we breathe every day. When the plastic is discarded, its microparticles reach our sewer system and are then dispersed into the sea. However, a considerable percentage of the particles end up trapped in the sewer system, which is then reused to fertilize our farms and fields. After drying, those particles can be picked up by the wind and dispersed throughout our air system.

KEY WORDS : pollution, plastic materials, recycling.

1. Introduction

Lead by the objective to reduce plastic pollution and the generation of plastic waste, over 300 cities in the USA and a couple of states have implemented laws for plastic bags, straws and EPS foam. The National Coalition of Environment Legislation (NCEL) declares that 34 states are considering around 200 legislative acts for managing plastic pollution. Surfrider, Plastic Pollution Coalition have developed kits of legislative tools for communities and states to restrict or outright ban plastic products.

Ever since the 1950, mankind has created approximately 8.3 billion metric tons of plastic. Plastic is now clogging our draining canals and is spreading in parks, reservations and mountains. The effect of plastic ,however, doesn't stop here, because the natural process of drainage continues the spread of plastic in our lakes, rivers and oceans. Scientists claim that about 8 million tons of plastic enter our water systems each year, adding up to a total number of 51 trillion particles so far. This number is far greater than even the number of stars in the Milky Way.

2. Current Stage

The equivalent of 65 garbe trucks of plastic waste is thrown in the ocean each day in the United States. Companies that produce and sell plastic and plastic products of single or multiple use continue to claim that recycling is the main solution to plastic pollution. The endless focus on recycling plastic packaging fails in the face of obvious facts :the recycling of plastic after use is, in general, economically not viable. For example cups and caps made out of polypropylene, promoted as recyclable by fast-food companies are not recycled in an ever increasing amount of countries and places on the globe. As such,there is about 6 times more plastic waste being burned than recycled after use.

The most important aspect, is that there is no proof that recycling plastic materials or the access to recycling bins truly reduce plastic pollution. Actually,, in the study *The Behavioral Economics of Recycling* in Harvard Business Review from October 2016, Remi Trudel from the University of Boston ran tests proving that people used more cups and plastic wrapping when recycling bins were available.Following the tests, discoveries were made that suggested the fact that "consumers feel more comfortable using a larger quantity of plastic when recycling is an option."

Bottle filling stations and taxes on plastic bottles for drinks; The best strategy to reduce plastic pollution for drinks is to make it easier for people to use less single-use bottles, and to make sure that no bottle is left behind. Public water refilling stations are necessary for reducing the consumption of water bottles made of single-use plastic. Towns and their water companies benefit installing refilling stations

which offer the function of refilling, plus a drinking fountain. People are offered high quality, free drinking water, and plastic waste is reduced.

A large part of plastic is considered toxic and as such, this cumulation of plastic wrecks not only mankind, but also our compatriots on this planet, the animals. These toxins can affect hormones related to health and can serve as a magnet, attracting other pollutants which may have more dangerous effects.

Plastic pollution can even contaminate the air we breathe every day. When plastic is thrown away, the microparticles reach pir sewage system and are then dispersed into the sea. However, a large number o particles still get caught in the sewage system, which is then treated and then a part of the water with plastic is reused and ends up being used to fertilize farms and fields. After drying , this particles may be picked up by the wind and spread out in the air which we breathe.

Most plastic products never truly disappear; they get smaller and smaller. A lot of these minuscule plastic particles are swallowed by farm animals or fish which mistake them for food, and as such they may find their way into our plates.Also, the plastic residue has also been found in most tap water in the world. By clogging sewers and offering breeding grounds for mosquitoes and other pests, -especially plastic bags- may raise the risk of transmitting diseases, such as malaria .

Plastic plays an important role in our everyday life. Plastic materials are used to create products that we use all the time, such as toys, furniture, containers, clothes etc. Also, the usage of plastic has exponentially increased from what it was 50 years ago, since it is a cheap material and it’s easy to give a shape to. The greatest quantity of plastic materials is found in most containers and packaging(soda bottles, shampoo bottles, lids, etc.), but also in more long lasting goods(household appliances) and less long-lasting goods (diapers, bags, mugs and household utensils, alongside medical tools)

The Plastic Material Industry Society of the United States has created a system to code plastic, which is even used today. It was meant to ease the distinguishing of different types of plastics by consumers, for as an efficient recycling as possible. The system is made of numbers from 1 to 7, the easiest to recycle plastsic to recycle is type 1 and it mainly contains polyethylene terephthalate (PET), also known as water bottles, pill bottles and many other containers used for goods meant for consumption.Once processed, the PET may become a synthetic fiber for clothes, sleeping bags, rescue vests,car bumpers, etc. Type two means plastic made from high density polyethylene. In this category we have containers and bottles for detergents, bleach, shampoo, motor oil or milk. In the category of plastics which are recycled less often because of it’s low recyclability level , we have type 3, 4 and 5. Type 3 is PVC(Polyvinyl chloride) used for pipes, shower curtains, medical instruments, etc. Number 4 (low density polyethylene, used for shopping bags and the like) and number 5(polypropylene used in various plastic wrappings, etc.).Type 6 is polystyrene which is used for coffee cups, disposable cutlery, insulation, etc. It can be reprocessed very easily, especially into a rigid foam used for insulating. The most difficult to recycle plastic is type 7, which is made from a combination of the aforementioned materials or rarely used types of plastic.

3. Recycling of plastic

Our storage space for garbage is rapidly dwindling. The growth of human population means that livable terrain is becoming more and more valuable. The adequate management o waste by reutilizing plastic materials can save a significant amount of space, up to 7.4 cubic meters of space can be saved by recycling one ton of plastic. Millions of barrels of oil are used to fuel the demand of plastic materials in a single year. Recycling plastic materials is the most solid option when it comes to also reducing the consumption of fossil fuels. Because oil is a finite natural resource, recycling plastic and recovering as much material as possible, the amount of oil consumed can be significantly reduced. Also, the recycling of plastic saves about 7.200 kilowatt-hour of electric energy.

3D printers use electricity to melt plastic or other materials when printing. If this is a negative impact on the environment or not, will depend on where the electricity comes from, much like an electric car. If you produce your own energy using solar power, the impact will be next to none. When they are used industrially, 3D printed pieces can have a great impact, especially when it comes to transport. For

example, a 3D printed auto component which is hollow instead of being filled with metal or plastic is a lot lighter, and the weight of the component dictates how much energy is being consumed during the life of the component.Additive construction also allows an increased complexity, and GE used this to great effect for higher quality engines and less work required, alongside less defects. All these lower the impact made upon the environment.

The biggest problem we face when 3D printing is the recycled filament, namely the mess.Cleaning of plastic bottles for recycling into filament requires a lot of effort. Now imagine you do this with tons of plastic which also come from dumps where they were contaminated with all kinds of impurities.

We must also keep in mind that different kinds of plastic produce different types of filament. High density polyethylene – shampoo bottles, for example- are rather easy to turn into filament, but is difficult to print with because it shirnks a lot more than other plastic materials as it cools. On the other hand, PET plastic prints well, but is fragile, which makes it difficult to turn the filament into a spool.

Recently, we have seen different kinds of researchers explore the main source of 3D printing material, made from plastic containers, left on the battlefield, which, we hope, can be repurposed in other activity sectors. There is also, Ethic Filament, a company whose purpose is promoting the concept of recycling for making ethically sourced 3D printing filament, which is then sold to improve the life quality of people in the entire world. There is also the Perpetual Plastic Project (PPP), which is a machine that can directly recycle old plastic cups in 3d printing gadgets, or other products, depending on what is needed.

The recycling of plastic into filament usually requires it being cut into small parts and then pushed through a screw extruder.A different approach adopted by the PetBot company, which cuts PET bottles into long strips and then turns them into filament. The cutting of the strip and the extrusion take place in two completely separate processes, on the same machine. A pet bottle is prepared by cutting off the bottom, and the open edge is then pushed by bearings, where a cutter turns the bottle into a long strip, while a rotating spool rolls it. The spool made of the strip is then moved to the second stage of the machine, which then pulls the strip through a hot end, similar to a 3D printer.

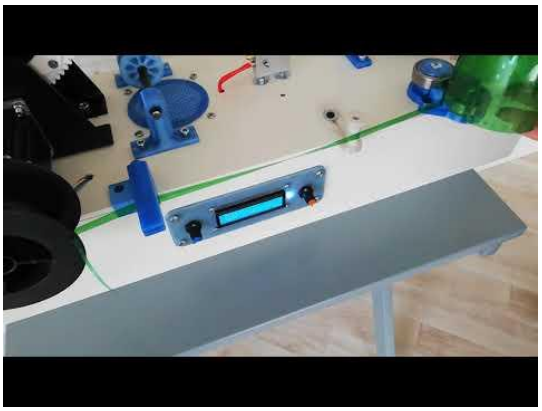

Fig.1. Recycling of plastic by turning it into filament from PET bottles.

While the majority of conventional extruders push the plastic through a screw nozzle, PetBot warms the strip with just a little over the glassy transition temperature, which allows the coil to slowly pull the strip through the nozzle, without breaking. A ventilator cools the filament right before it goes on the 2nd spool, the same step-by-step engine is used for both stages of the process.

This model is a lot simpler in comparison to a regular screw extruder, but it is not without flaw or compromises. First and foremost, the length of the filament is limited to the material from a single bottle. Obtaining longer length filaments would mean you would need to melt the strip after cutting or to melt the filament after extruding, which isn't as easy at it looks. The process would probably be limited to a large bottle of water, with smooth exterior surfaces to allow the width and the thickness of the strip to be as consistent as possible.

4. In conclusion

When we recycle , used-up materials become new products, reducing the need to consume more natural resources. If the materials used are not recycled, there will be new products created by extracting more natural resources from Earth, such as mining and forestry. Recycling helps to conserve natural resources and protects natural habitats for the future.

The reduction of waste, recycling and composting are efficient ways to reduce greenhouse gas production, such as carbon dioxide and methane. Because recycling implies using a less amount of energy for obtaining and manufacturing new material, there will be less carbon emissions.

Recycling is fundamental in promoting a circular economy, this being the new paradigm of durability, capable of reducing the negative effects done to the environment, and to contribute to creating new opportunities for jobs. According to Greenpoint Management, in the case of Romania, 10.000 tons of recycled wastes means 16 new job spots.

Recycling must be viewed as a collective responsibility, of each of us, in order to assure a durable and safe future. The responsibility of economic agents is to offer us the means to do so, but each person must contribute and offer initiative. Meanwhile, recycling brings many benefits, both to us and our environment.

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EMMERGENCY SITUATIONS. RISK OF INJURY BY FIRE OR EARTHQUAKE AT WORK. CASE STUDY

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SUMMARY: Within this paper will be presented prevention and protection measures applied in case of a fire inside the Faculty of Industrial and Robotic Engineering according to the regulations in force. The presentation of the application of the protection measures to be taken in the event of a fire, the simulation of the evacuation in case of fire, as well as the first aid measures to be applied until the intervention of specialized medical staff is considered.

CUVINTE CHEIE: prevenire, protective, incendiu, reglementari, prim-ajutor

1. Introduction

Occupational protection is the set of actions and measures to prevent occupational risks, to protect the health and safety of workers, to eliminate risk and injury factors by informing, consulting, training, protecting workers and their representatives.

Occupational safety and health is the set of institutionalized activities aimed at ensuring the best conditions in the work process, defending life, physical and mental integrity, the health of workers and other persons participating in the work process

Serious and imminent danger of injury is the concrete, real and current situation that lacks only the triggering opportunity to produce an accident at any time.

Occupational risk is the likelihood and severity of an injury or illness that occurs as a result of exposure to a hazard.

Fire refers to a self-sustaining combustion process, which is carried out without control in time and space, which causes loss of life and/or material damage and which requires an organized intervention in order to interrupt the combustion process (see Fig. 1.).

To break out a fire, 3 elements are needed: heat, oxygen and combustible material, the fire most often starting from a small fire.

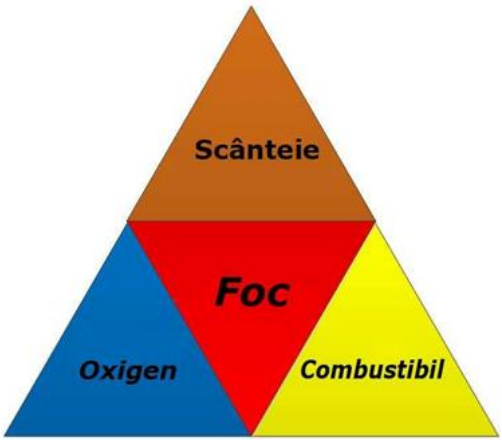

Fig. 1 Fire diagram

2. State

Inside the Faculty of Industrial Engineering and Robotics, the alarm is activated in order to produce a fire on the first floor of the main body in the laboratory room containing several electrical equipment (computers, laptops, video projector, extension cords).

Due to the overloading of an extension cord supplying more than three work equipment, a short circuit occurred that led to the melting of the plastic material and its ignition (see Fig. 2). Near the electrical equipment was improperly positioned combustible material (backpack), which led to the outbreak of the fire.

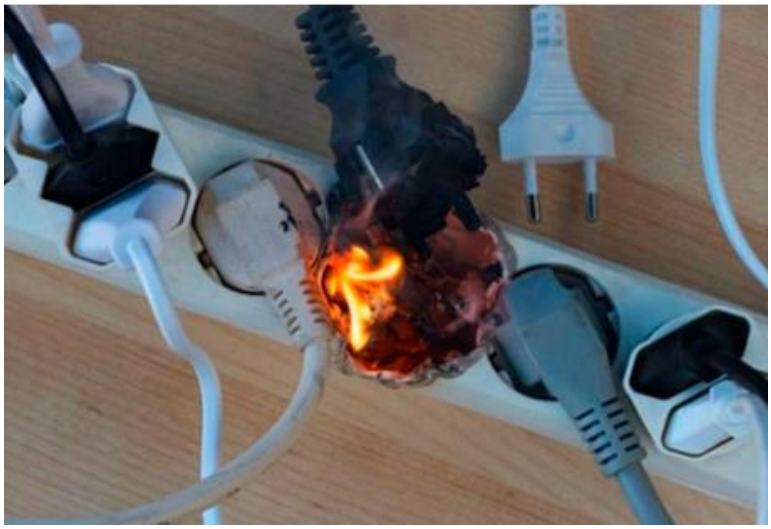

Fig. 1. Electrical equipment the cause of the fire

Number of people present in the classroom at the time and time of the fire:
-15 students;
-Teacher;
-Laboratory assistant;
Affected areas:
-Classroom;
-Hallway;
-The teacher's office;

Regarding the way of carrying out the actions, the specifications below are made. At the time of the fire alarm, the students were directed by the teacher participating in the course to the escape routes, maintaining a calm atmosphere, avoiding panic. After evacuating the laboratory room, the professor checked the possibility of the presence of trapped persons inside.

With the onset of the fire alarm within the faculty, all the classrooms were evacuated by the responsible teachers, the evacuation being organized, one by one, on the stairs (the elevator is not used), the students being guided to evacuate by holding on to the railing.

Once the students gather at the meeting place, the presence is carried out by the teachers.

The guide for organizing and conducting the evacuation in case of an emergency situation generated by the occurrence of a fire [4] provides measures, such as those listed below:

- All persons who are visitors or work in the faculty must be trained on how to behave correctly in the event of a fire (e.g. to move as close as possible to the floor in rooms where there is already smoke);

-Establishing the responsible persons, for each level, by checking the evacuation of all persons from all spaces related to that level;

- The unique emergency number 112 must be displayed in visible places inside the faculty;

- The fire alarm system must be functional;

-The alarm system to be known by all users of the faculty;

- The evacuation plan must be drawn up on the basis of the outline of the level. The evacuation plan is recommended for displaying information specific to emergency situations (escape routes, materials for interventions). (see Fig. 3);

Fig. 3. Evacuation plan

-The escape and rescue paths from the faculty (corridors, stairs, exits) leading to the established assembly place must be permanently usable [2]

- The assembly places established by the management of the school must be located in a safe area, at safety distances from possible sources of danger; (see Fig. 4))

Fig. 4. Loc de adunare

-The person who will notice the fire will immediately call 112 and announce the incident. (In the event that the person who will notice the fire is a child, they will notify the first adult they meet about the event).

-All the windows of the rooms will be closed.

-The evacuation of all users to the outside of the building will be made according to the evacuation plans drawn up at the faculty level.

-Students and auxiliary persons leave the building under the supervision and guidance of the responsible persons, who will position themselves so that they can easily observe the evacuation action, closing the door of the room. They will follow them to the pre-established and properly marked meeting place where the presence will be urgently made [3].

- The staff responsible for checking the evacuation of all persons will check all the spaces related to each level of the faculty to ensure that there are no people left in those locations and that all students have left the rooms and announce the result of the officer throughout the faculty.

-The persons in charge make the presence of all persons, including those with disabilities and/or locomotor disabilities (non-displaced) who are accompanied by the persons nominated by written decision to help them and ensure their safe evacuation and announce the result of the faculty representative.

-The access ways to the faculty are opened and the traffic and access routes for the intervention vehicles of the specialized forces are issued;

- Enter the building only after the intervention and with the consent of the professional emergency services.

- If the fire is of small scale, it will be acted with the means of first intervention (extinguishers).

3. First aid

The steps for providing first aid (see fig. 5) must be observed with great strictness in order to obtain the expected effect.

Fig. 5. First aid steps

Below are the steps to be taken to provide first aid:

- The person who suffers an injury or other ascertainment immediately notifies a responsible person;

- Immediate steps are taken for the provision of first aid by trained personnel;

-If specialised medical help is required, a person in charge requests help by calling the unique emergency number 112;

-Provide first aid only to specially trained persons in this regard (thus avoiding possible aggravations of the situation);

4. Own evacuation instructions and informative material

In case of a fire, the persons responsible for evacuation in case of a fire within the faculty will carry out the following activities, based on their own evacuation instructions and information materials [4].

- Immediately identifies the burned-out room;
-Alarms the users of the building;
-Announces to the head of the faculty;
-Evacuates people from the faculty, materials and values threatened by fire;
-Interrupts the supply of electricity in the faculty;
-Checks the accessible rooms in the area of responsibility;
-Directs users to the nearest emergency route for the evacuation of the faculty;
-Maintain calm during evacuation;
-Takes control over the assembly place;
-Apply measures to protect people against smoke poisoning;
-Insulates the firebox by closing doors, windows and other constructive voids;
- It is actuated with the extinguishing means provided;
-Material goods are not evicted.

When a fire is discovered, any person has the following obligations:

-Immediate announcement of the fire;
-Trying to put out the fire, if it is not risky, using the nearest extinguisher, only if the fire does not exceed the level of the basin [7];
-Announcement by Telefonica 112;
-Communicate details of the location and extent of the fire. [7];
-Equipment from the endowment of the Faculty of Industrial Engineering and Robotics in case of fire: (see fig. 6 and 7)
-Fire alarm [7];
-Beacons of escape routes (see fig.8);

Fig. 6. Fire extinguisher

Fig. 7. Hydrant


Fig. 8. Light box for highlighting the escape path

5. Legislation

Teachers, students and other staff must comply with the legislative norms in force.

Art. 1.39. Pupils, students and teachers are obliged to know and comply with the rules and measures of fire prevention and extinguishing in the respective unit (education and, as the case may be, dormitory).

Art. 1.40. If they become aware of fire protection irregularities in the unit, they will immediately notify the management.

Art. 1.41. To know the fire signal and how to evacuate under orderly conditions in case of fire or natural disasters.

Regarding the alarm and alerting in case of incensium, the legislative norms in force must also be observed.

Art. 2.115. For fire alarm, appropriate means of signalling (acoustic and optical) will be provided to ensure the announcement (alarm) of the staff and the alerting of the civil fire service (when any). At the same time, it will be ensured the possibility of alerting in the shortest time the intervention forces provided in the intervention plans (by telephone, radiotelephone, courier, etc.).

Art. 2.116. Staff will be trained to know the means of alarming and alerting in case of fire, as well as the established signal code.

Art. 2.117. The important and vulnerable units to fire will have maintained the direct connection with the nearest military firefighting subunit, the respective alerting system being established by mutual agreement (telephone, radiotelephone, automatic alerting from the fire signaling installation, etc.)

In case of a fire, the persons responsible for evacuation in case of a fire within the faculty will carry out the following activities, based on their own evacuation instructions and information materials [4].

Regarding the lecture halls, libraries, design workshops, festivities halls, amphitheaters, auditoriums, exhibitions, the legislative norms in the fields must also be observed.Art. 3.1.

In classrooms, libraries, design workshops, clubs and performance halls, exhibitions are not allowed access to a larger number of users (persons) than established by the project, depending on the destination of the buildings in which they are located (kindergartens, primary schools, middle schools, high schools, vocational and post-secondary schools, higher education institutions or other categories of public buildings).

Article 3.2. It is forbidden to smoke and use open fires in such rooms, as well as open flame lighting (candles, matches, torches, etc.) in attics, archives, warehouses, other rooms, spaces and places with fire risk in the buildings in which they are located.

Article 3.3. In rooms and rooms where heating is done with stoves, their fuel supply will usually be interrupted before users enter them. For those rooms that are intended for preschool children (nurseries, kindergartens, dormitories, etc.) the fuel stoves are supplied only from outside the rooms.

6. Conclusions

The safety of the evacuation of a faculty must be ensured, mainly, by the following elements: the escape routes must be sufficient in number, safe, light, accessible and sufficiently protected from the effects of fire, the escape routes must be correctly signaled and be visible in case of clearance. smoke, smoke extraction systems and all extinguishing systems in the equipment of the objective must be in working order at the parameters at which they were designed and built. In the event of a fire, once the alarm system has been put into operation, all users must be able to reach safe places, at the meeting place, outside the faculty where it occurred.

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NANOMATERIALS USED IN THE FIELD OF MEDICINE

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ABSTRACT: Nanomaterials can be defined as materials possessing, at minimum, one external dimension measuring 1-100nm.Nanomaterials can occur naturally, be created as the by-products of combustion reactions, or be produced purposefully through engineering to perform a specialised function. Nanomedicine involves the use of nanotechnology for clinical applications and holds promise to improve treatments. Recent developments offer new hope for cancer detection, prevention and treatment. Personalized Medicine (PM) aims to revolutionize cancer therapy by matching the most effective treatment to individual patients. Nanotheranostics comprise a combination of therapy and diagnostic imaging incorporated in a nanosystem and are developed to fulfill the promise of PM by helping in the selection of treatments, the objective monitoring of response and the planning of follow-up therapy.

CUVINTE CHEIE: nanomaterials, nanomedicine, nanotechnology, nanosystem

1. Introduction

The topic of this paper is the following topic of discussion -What are nanomaterials and what is their purpose in medicine-?

Nanomaterials are chemicals or materials whose particles are at least 1 to 100 nanometers in size. Due to the fact that, at the same volume, the specific surface area is larger, nanomaterials may have different characteristics from those of the same material without nanometric structure. Therefore, the physicochemical properties of nanomaterials may differ from those of bulk substances or larger particle.

The topic is approached with interest, it represents an overview, oriented both to the knowledge of the term NANOMATERIALS and to the knowledge of their functions.

The information is gathered from sources carefully studied by specialists in the field.

The paper is based on the structure, language and instructions learned in the information technology course.

2. What are nanomaterials?

The term nanoscale refers to the size of 10-9 meters. It's the billionth part of a meter. Thus, particles whose external size or internal structure size or surface structure size is in the range of 1nm to 100nm are considered to be nanomaterials. These materials are invisible to the naked eye. The materials science approach of nanotechnology is being considered for nanomaterials. At this scale, these materials have unique optical, electronic, mechanical, and quantum properties compared to their molecular-scale behavior.

3. Classification of nanomaterials

The classification of nanomaterials depends mainly on their morphology and structure, they are classified into two major groups as consolidated materials and nanodispersions. Enhanced nanomaterials are further classified into several groups. One-dimensional dispersive Nano systems are called

Nanopowders and Nanoparticles. Here nanoparticles are further classified as nanocrystals, nanoclusters, nanotubes, supermolecules, etc. For nanomaterials, size is an important physical attribute.

Nanomaterials are often classified according to their nanoscale size. Nanomaterials whose all three dimensions are nanomatically scale and which show no significant difference between the longest and shortest axes are called nanoparticles. Materials with their two nanoscale sizes are called Nanofibers. Empty nanofibers are known as nanotubes, and solid ones are known as nanorods.

Based on the phases of matter contained in nanostructured materials, they are classified as nanocomposite, nanofoam, nanoporous and nanocrystalline materials. Solid materials that contain at least one physically or chemically distinct region with at least one nanoscale-sized region are called Nano Composites. Nanofoams contain a liquid or solid matrix, filled with a gaseous phase and one of the two phases is nanoscale in size.

4. What are the properties of nanomaterials?

Nanotechnologies make it possible to obtain innovative materials and devices with new properties.

1. Crystalline structure

The crystal structure of the nanoparticles is different from that of the macrocrystalline material: - the zirconium oxide nanoparticles are tetragonal / cubic (the equilibrium structure is monoclinic).

2. Electronic structure

The electronic band structure changes at the nanoscale: - in the TiO2se nanoparticles there is a change in the width of the forbidden band (in the sense of decreasing it); - Hg nanoparticles <2 nm show non-metallic conduction.

3. Optical properties

The optoelectronic behavior of nanoparticles is different from that of densified material: - The wavelength of the emitted light depends on the particle size at the nanometer scale.

4. Diffusion

Atomic diffusion in nanoparticles is different from that in materials with crystalline micro-grains: - exponential dependence on particle size; - surface effects.7.

5. Solubility

Substances that are not micrometrically soluble may become nanometrically soluble.

6. Mechanical properties

The mechanical properties of nanocrystalline materials are very different:

- dislocations influence the ductility and mechanical strength of microcrystalline materials; - the slippage of the dislocations determines the appearance of the deformations and eventually the destruction of the solid body;
- dislocation activity decreases as the size of crystalline grains decreases;
- dislocations are absent in nanocrystals with dimensions of 10-20 nm.

5. What are nanorobots?

Early diagnosis and guidance of cancer drugs, biomedical tools, surgery, pharmacokinetic monitoring (a branch of pharmacology that studies the phenomena involved in the processes of absorption, distribution, transformation and elimination of drugs from the body) of diabetes and health care.

Nanotechnology offers a wide range of new technologies for the development of customized solutions that optimize the delivery of pharmaceutical products. Today, harmful side effects of treatments, such as chemotherapy, are usually the result of drug delivery methods that do not indicate high accuracy in target cells. That's why Harvard researchers were able to create nanoparticles, which they filled with chemotherapy drugs. These particles are attracted to cancer cells. When a nanoparticle encounters a

cancer cell, it adheres to it and releases the drug into the cancer cell. This directed method of administering drugs has the potential to treat cancer patients and at the same time avoid adverse effects (usually associated with improper administration of drugs).

Fig.2. Nanorobot

Another useful application of nanorobots is to help repair tissue cells along with white blood cells. Recruitment of inflammatory cells or white blood cells to the affected area is the first reaction of the injured tissues. Due to their very small size, nano-robots could attach to the surface of recruited white blood cells, shorten their path through the walls of blood vessels and reach the affected area, where they can aid in the repair process. of tissues. Certain substances may also be used to speed up recovery.

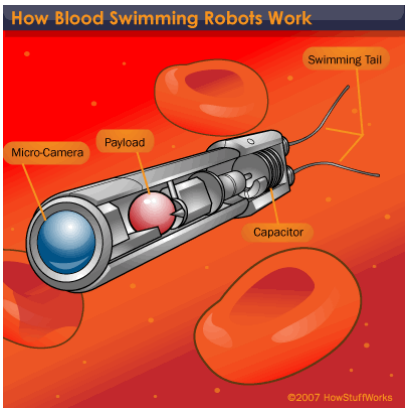

Fig.3. Nanorobot components

6. What are the advantages of molecular nanotechnology?

With the stated goal of eradicating all common diseases known in the 20th century, pain and suffering, nanomedicine is the main weapon of war, especially in areas where traditional medicine has proved insufficient. The advantages of molecular nanotechnology in all branches of medicine are many, here are the most obvious:

-possibility of more accurate and faster diagnosis of diseases
-accelerated effects of treatments by targeting them even on diseased cells
- reducing the danger of side effects by protecting areas where treatment is not necessary
-verifying the progress of the treatment by following the behavior of the treated organs
- tests performed directly on diseased organs

But the extraordinary elements introduced by nanomedicine are nanorobots. Tiny particles, with dimensions between 0.5 and 3 microns, formed mainly of carbon, but also of hydrogen, oxygen, nitrogen,

sulfur, fluorine, silicon, nanorobots are introduced directly into the bloodstream in which they "paddle" diligently to diseased organs or which must be analyzed.

7. Conclusions

Before medicine progressed, until the Middle Ages and until the end of this period, the only method that doctors believed could cure a person was a small incision in the arm area to allow blood to flow.

With the evolution of technology, nanotechnology has emerged that has been introduced into medicine, resulting in nanomedicine. It is looking for ways to cure people with certain diseases from the onset of the disease at the molecular level, so that it can no longer spread.

The introduction of nanorobots into medicine would revolutionize the world of medicine and completely change life on earth. The introduction of a nanorobot into a human body would have many advantages, namely: it would walk in the human body and go immediately to the cells where there would be problems and would repair them immediately without giving the virus a chance to evolve, there would be no need for surgery, there would be a healthier population, diseases that are common today, probably would no longer exist and this technology would increase a person's life rate.

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THEORETICAL APPROACHES OF LINEAR AND NON-LINEAR ACTIVE CONTROL OF RAILWAY VEHICLES. STUDY OF THE FRICTION AND ADHESION OF THE WHEELS OF RAILWAY VEHICLES WITH THE HELP OF DYNAMIC MODELING.

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ABSTRACT: The paper describes the development of the form of auto-oscillations in case of rotation of the traction unit which is affected by a combination of random conditions and the development of rotation, the effects of shock vibrations in operation, the presence of subharmonic resonances and external disturbances at frequencies close to auto-oscillations. Due to the fact that the self-oscillations of a pair of wheels are the most typical form of self-oscillation for known drive structures, in order to reduce the self-oscillations to a safe level, it is proposed to use energy dissipation on impacts in the transmission gear.

KEYWORDS: wheels, shocks, self-oscillations, resonances.

1. Introduction

1.1 Friction and tightening of railway vehicle wheels

Adhesion or adhesion coefficient is given by the ratio of tangential longitudinal force (i.e. braking or tracking) to the normal force at wheel rail contact. The tangential force that a braked or trailed wheel can exert on a rail is limited by the friction coefficient available between the surfaces coming into contact for a given normal load [1]. In contact with clean steel, the friction coefficient is known to be higher than the adhesion requirements for normal traction and braking operations of existing rolling stock. However, contamination such as leaves, grease and water can easily occur at the wheel-rail contact reducing friction leading to low grip problems [2]. When there is a low grip, train delays can be the clearest consequence for commuters traveling by rail. However, many other negative effects can occur, such as damage to the wheels and rails, overtaking of the station platform and even collisions. Therefore, not only the reliability, but also the also the safety and costs of rail transport can be compromised.

1.2. Friction

Friction is defined as the force of resistance tangent to the common boundary between two bodies when, under the action of an external force, one body moves or tends to move relative to the surface of the other body [1].

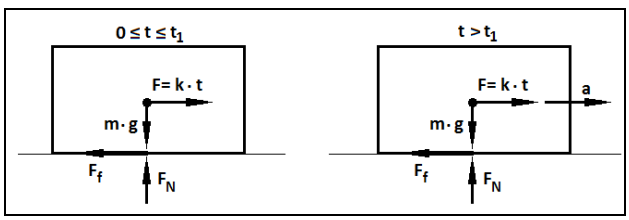

Fig. 1. The forces applied on a on a solid body rectangular on a horizontal plane

The friction is normally the friction coefficient f, which is defined as the ratio between the frictional force F_f to the normal force F_N in contact between the two bodies, as shown in relation (1):

$$f = \frac{F_f}{F_N} \tag{1}$$

Figure 1 shows a solid rectangular body of mass m leaning on a horizontal plane. If a force F is applied, parallel to the plane and increasing in time, to the center of mass, as shown in Figure 1, where k is an arbitrarily positive constant and t time, there will be a time t_1 when the body begins to slide on the plane. The friction that opposes the start of the movement is called static friction.

The coefficient of static friction fs is given in relation (2), where g is the acceleration due to gravity. From that moment, the body slides with an acceleration a, and the force that opposes the sliding motion of the body is called kinetic friction (or dynamic friction). The instantaneous kinetic coefficient of friction f_k at a t_2 is given by the relation (3), where a_2 is the acceleration of the respective body at the t_2 moment.

$$f_s = f(t = t_1) = \frac{k \cdot t_1}{m \cdot g} \tag{2}$$

$$f_k = f(t = t_2) = \frac{k \cdot t_2 - m \cdot a_2}{m \cdot g} \tag{3}$$

In most tribological pairs, static friction is greater than kinetic friction, with the difference being dependent on materials and contact conditions (relation 1). In the case of steel used for rail wheels and rails, laboratory investigations have shown that the coefficient of static friction can be up to almost twice the coefficient of kinetic friction (relation 3).

2. Modeling of the railway vehicle wheels

Modeling means many things, so it is necessary to start by defining what this means regarding research. The aim of this paper is to investigate advanced braking strategies. Modeling and simulation are part of the analysis and design process in most engineering projects and are essential in all but the simplest system. The difference between modeling and simulation is that a model is a simplified representation of a system, and simulation is an adapted model for simulation on a computer, i.e. mathematical or logical relationships and operational rules embedded in the computer program, which are known together as a simulation model on a computer or simple simulation model [1].

The simulation is similar to laboratory experiments performed by scientists to gain insight into existing theories or to develop and validate new theories. Studying the behavior of the system through these indirect methods (i.e. by modeling and simulation) becomes a necessity in many situations where no other alternative is possible (e.g. observation, analysis, experimentation, non-destructive testing etc.) or the available alternatives are not effective or they are too expensive.

This paper presents a model that illustrates the interaction due to braking between the wheel of a railway vehicle and the rail. It also shows the derivation of the motion equations for a single set of wheels of the railway vehicle. These well-established equations were used a few years ago to solve the problems of railway dynamics.

The paper also describes the methods that are currently being developed to evaluate the braking control systems of railway vehicles. These systems are needed for high performance control strategies [2]. The effects of shaping the rail and wheel are demonstrated when the brake shoes are applied to the wheel. Both linear and non-linear situations are studied, as well as the effects they have on the vehicle dynamics.

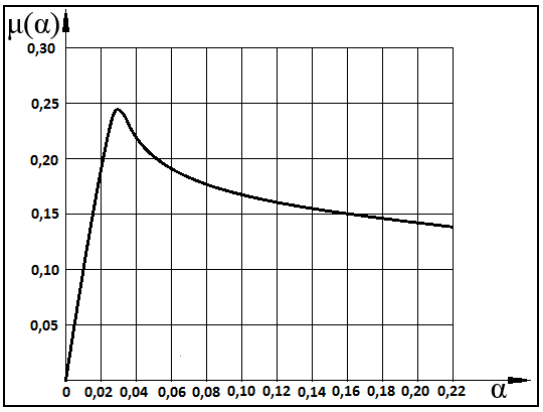

Fig. 2. Coefficient μ to a α in dry conditions

In the first phase, brake shoes were used that acted on the edge of the wheel. At present, the brake discs are mounted either on the wheel itself or on the mounted axle, and in some cases in both places. Clog brakes on the wheels of the railway vehicle are the type of brakes that remain the most widely used worldwide, although technology has changed and improved a lot over time.

A fundamental aspect is that the maximum towing effort (or braking) that can be transmitted is the product of the predominant adhesion factor and the vertical reaction force. The maximum axle load depends on the maximum speed and unprotected mass and therefore the maximum towing or braking effort that could be transmitted. For wheel-rail contact, surface conditions, both in terms of smoothness and cleanliness, significantly affect adhesion. The adhesion factor also varies depending on the speed of sliding between the wheel and the rail [3]. The distribution at a low friction condition is accentuated, as shown in Figure 1, which shows the coefficient of friction compared to the slip coefficient.

This fact, coupled with the high inherent inertia in all rail wheels, means that the most sliding systems focus on detecting slip as quickly as possible and taking corrective action.

Mathematical models are developed for the design and evaluation of advanced braking control strategies for high performance railway vehicles [4]. The modeling includes both linear dynamics and non-linear braking forces generated at the wheel-rail contact. The equations of motion for a single wheel and the braking effect of a single wheel are discussed in the next section.

The results of a progression of increasing complexity models are then presented. As the understanding of the dynamic behavior of a wheel is fundamental to the study of the dynamics of a railway vehicle, it is first considered an isolated wheel moving along the rail [5]. These equations are extended to the case of a rigid frame supported on two wheels, representing a single bogie. This model is further extended to represent a single vehicle and finally to a multi-vehicle train.

2.1 Interaction between wheel and rail

The wheels of the railway vehicle are in the form of two wheels rigidly mounted on a common axle. In a superficial view, the behavior of a wheel of a railway vehicle is determined by purely geometric effects. Pure rolling motion is altered by the action of tangential forces at the wheel-rail contact point. These forces induce sudden slip or slight slip. This is important in the behavior of wheel-rail contact [6].

The mechanism of the braking system works according to the following sequence. The brake shoes are pushed on a disc mounted either on the axle or on the wheel. The force generated by the support reacts through a suspended brake caliper connected to the bogie frame. This opposes the rotation of the wheel and creates an elastic deformation of the contact space between the wheel and the rail. As a result, a longitudinal braking force is developed, the longitudinal braking force. The theory of this mechanism is based on sliding or factional difference between the peripheral speed of the wheel and the speed of the train. The relationship between the coefficient of friction μ and the slip α, depends on the materials, but for steel wheels and rails, it is usually as shown in Figure 10, which also indicates the adhesion limit [7].

The geometric features of interest refer to the behavior of the point of contact on each wheel where the slight slip is created. A formal definition of slip based on the variables shown in Figure 2 is given in relation 4:

$$\alpha = \frac{2 \cdot (RW \cdot \omega - V)}{(RW \cdot \omega + V)} \tag{4}$$

The longitudinal slip is defined in terms of the speed with which the rolling stock passes through the rail-wheel contact area and is expressed as the difference between the components in the longitudinal direction of these rigid body speeds divided by the wheel forward speed. The slip is produced by a tangential force and a moment of the normal axis. The tangential force is usually also solved by its longitudinal and lateral components, although this work only refers to sliding and force in the longitudinal direction. Instead, the slip can be considered as specified and the force and moment calculated from it. In the theoretical work, this is the general case.

2.2 The movement equation of the wheel

The dynamic model of the wheel should be as simple as possible. For simulation and analysis purposes it should also contain all the important parameters of the particular properties that are being investigated on the dynamic system of the whole vehicle [8].

Figure 3 shows the forces acting on a single wheel under the braking action.

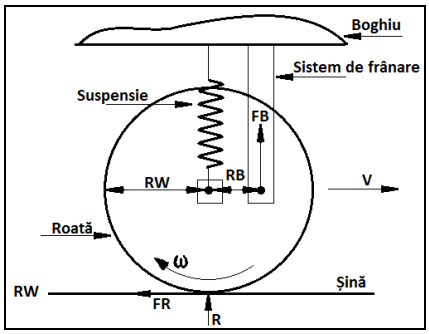

Fig. 3. Vehicle dynamic system parameters

For the motion of a mounted axle with small speed differences in relation to the path on which it travels, the slip α is given by the relation:

$$\alpha = \frac{(RW \cdot \omega - V)}{V} \tag{5}$$

in which RW is the radius of the wheel, ω is the angular velocity and V is the forward speed of the wheel. For braking, result negative values of an angular velocity value ω.

When the speed difference is a significant proportion of the wheel or rail speed, it is more appropriate to use the following equation, in which the difference is divided by the average speed (relation (5)). The relationship (6) was used because, although there is some increase in computational complexity, the simulation was expected to reach high levels of sliding in certain circumstances and therefore a more precise equation must be used.

The dynamic equation of the wheel is therefore as follows:

$$IW \cdot \alpha = FR \cdot RW - EB \cdot RB \tag{6}$$

in which IW is the moment of inertia of the mounted axle and where:

$$FR = \mu(\alpha) \cdot R \tag{7}$$

The coefficient of friction $\mu(\alpha)$ is a non-linear relation, usually presented (figure 10) for dry rails, where the same characteristic applies to the negative values of the slip encountered during braking [9]. The equation can be substantially linear for a small braking force (for which the grip is approximately proportional to the slip) but is obviously very nonlinear as the grip limit approaches.

The equation of the linear longitudinal braking force FR is:

$$FR = \frac{R(RW \cdot \omega - V) \cdot C_C}{V} \tag{8}$$

where R is the reaction force and C_C is the slope of the graph for the small value α.

The longitudinal braking force FR also depends on the reaction force R. However, this force will change as result of the redistribution of wheel loads during braking, an effect which also depends on the dynamic properties of the vehicle's suspension [10]. This effect creates the interaction between the braking systems of the different axles mounted in a train [11] and which must be properly understood and modeled to allow the determination of the maximum potential of high-performance braking systems.

2.3 Breaking of one wheel

There are several parameters that are used to model the braking behavior of a single wheel. These are the wheelbase RW = 0.5 m, the distance from the center of the wheel to the brake arm, RB = 0.25 m and a quarter of the mass of the train, R = 7853.5 kg for 77042.8 N. For all preliminary studies a train starting speed V = 20 ms-1, although at a later stage the results were also evaluated at higher and lower speeds. For a single dynamic mounted axle [12] it is simply represented by:

$$MV = -FR \tag{9}$$

A brake application was simulated to illustrate the effect of brakes on the speed, slip and angular velocity of a single wheel running on a railway.

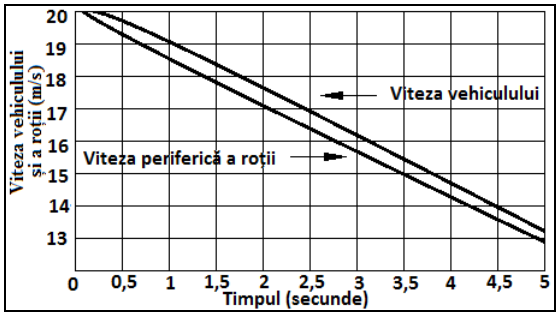

Fig. 4. Linear wheel speed and peripheral wheel speed

In this case, a linear adhesion-slip feature was used (only the FB limitation, so that the adhesion limit is not exceeded). The simulation results show that as the brakes are applied, the vehicle speed and the wheel speed start to decrease, the speed of the fall depends on the braking force [13]. The simulation was stopped when the speed of the mounted axle [14] reached zero. Figure 4 shows the linear wheel speed and the peripheral wheel speed, while figure 5 shows the longitudinal braking force.

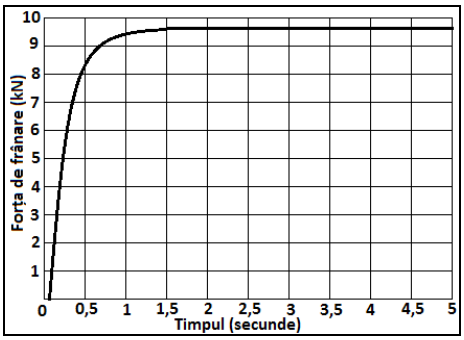

Fig. 5. Longitudinal braking force

The results of a steadily increasing force FB, which creates a longitudinal braking that exceeds the adhesion limit, are shown in Figure 5. The chart above shows the speed of the train and the peripheral speed of the wheel. The difference is small due to the low level of slip that exists for the steel at the contact of the steel. The graph below shows the longitudinal braking force, FR, which is generated at the wheel-rail contact point. At this stage, the braking force FB = 60 kN and the longitudinal braking FR are as shown in Figure 6, but all other parameters are the same as before.

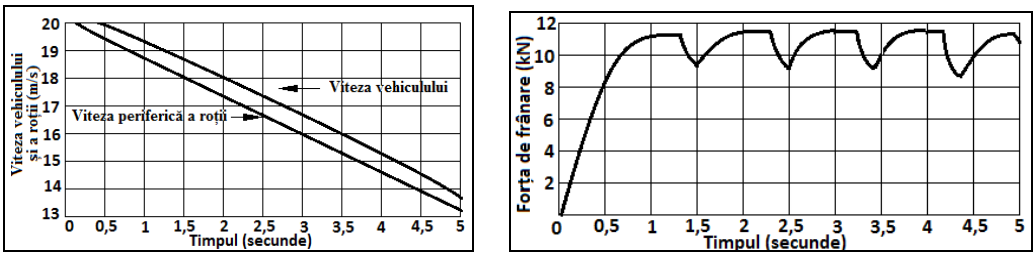

Fig. 6. Braking of a single mounted axle with easy wheel slip control

The developing simulation includes a simple control law representative of current practice, which stops the braking effort if the slip exceeds a value of 0.03 and reapplies it when the wheel stops slipping.

2.4 Wheel sliding control

Wheeled vehicles are usually braked on their wheels and, although there are used different types of auxiliary braking systems, friction brakes are normally used as the most popular means of decelerating or stopping the vehicle [15].

The frictional force is developed between the wheel and the rail when the wheel is braked. The braking force is the available output force that will be used to decelerate or stop the train. Figure 7 shows the diagram of the braking scheme, including a first-order filter to represent the dynamics of the braking system. The input is a slip signal and if the slip value is below the maximum allowable value, then it will allow braking to be applied [16].

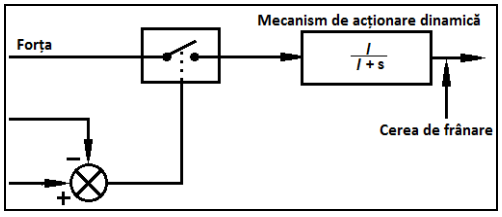

Fig. 7. The diagram of a single-wheel controlled braking

If the input signal has matched or exceeded the maximum allowed value, the brake will stop [17]. This force could have any profile, such as a step or a ramp, and a brake frame was used in these studies [18]. The time constant of the braking dynamics is typical of a pneumatic braking system [19].

The adhesion between wheel and rail is the limiting factor in rail braking performance [20].

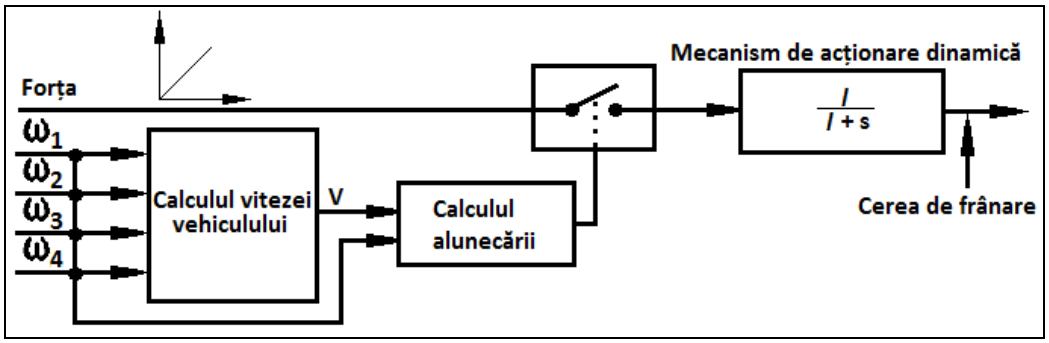

Fig. 8. The control design diagram of the vehicle device on a wheel

If the slip limit is exceeded once the brakes have been applied, then they are stopped immediately [21]. When the wheel recovers from slipping, the brakes are reapplied and this cycle is repeated. This control method [22] was implemented for the results in Figure 9.

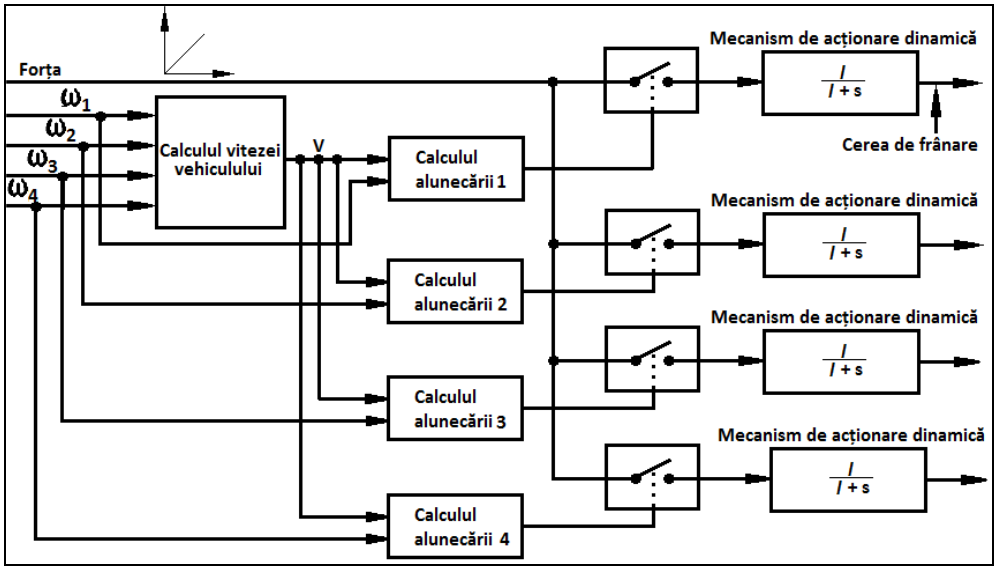

Fig. 9. The control design chart for four-wheel drive vehicles

The same unique sliding control system used on the mounted axle has been used in the bogie system, in which each mounted axle has an independent control system [23].

3. Conclusions

One can obviously speak of an advantage of the roller or ball follower (Module B), compared to the classic sole follower (Module C). Therefore, high speeds and higher efficiency can be obtained with the help of module B. By designing and adapting such a distribution mechanism on 2100 HP Diesel Electric locomotives, the vibrations from the distribution shaft (s) are largely eliminated, a better efficiency is obtained and the theoretical operation chart of the Diesel Engine is close to the ideal one.

The development of this or that form of self-oscillation in the case of traction unit rotation is affected by a combination of random conditions from the beginning and the development of rotation, the effects of shock vibrations in driving, the presence of subharmonic resonances and external disturbances at frequencies close to auto-oscillations frequencies.

Since the self-oscillations of a pair of wheels are the most typical form of self-oscillation for known drive structures, to reduce the self-oscillations to a safe level, it is proposed to use energy dissipation on impacts in the transmission gear.

The coefficient of adhesion is the ratio between the longitudinal tangential braking force and the traction force and the normal force in the wheel-rail contact plane. The tangential force that a braked wheel can exert on the rail is limited by the coefficient of friction available between the wheel and the rail at a given normal force. The coefficient of friction in clean steel contacts is usually higher than is required for normal braking and traction operations of rolling stock. However, leaf, grease and water pollution can easily occur in wheel-rail contact and reduce the level of friction due to problems of adhesion lacking. In recent years, problems have arisen in our country due to the presence of moisture and leaves and other pollution on the rails. Due to a lack of adhesion on the rails, voyages delay and many other negative effects can occur, such as damage to the wheels and the rail, ignoring signals and even collisions. Therefore, not only the reliability, but also the safety of rail transport is jeopardized due to adhesion problems.

The studies focused on the theoretical aspects, as well as on the aspects of numerical modeling and simulations. The technical approaches have been implemented by knowing the dynamic behavior of railway vehicles, specifying the actuators of active suspensions and their implementations. The technical aspects were primarily addressed by knowing the dynamics of the vehicles, their behavior, the analysis of driving stability and the related standardized indicators. Knowledge of previous experiences, research into new technologies and simulations have led to the synthesis of functional specifications and the choice of electromechanical technology to define the transverse and vertical actuations of active suspensions. The introduction of uncertainties in the nominal scheme leads to a change in equations and representation schemes, algebraic schemes. This new formulation can be used to analyze the stability of the assembly, once the control defined for the nominal system or to be used for the synthesis of a new controller, for a modified representation diagram. Synthesis (or DK iteration) is a method recommended especially in these situations.

The element that ensures the guidance of the railway vehicles on the two rails of the track is the mounted axle. The force acting on the wheel-rail contact area creates a moment of overturning of the axle and, thus, an additional load transfer depending on the wheel radius.

The effect of the interaction between the braking action of the individually mounted axle was analyzed. The evaluations included the effect of simple control laws to prevent the wheels from slipping during braking.

The next step in the research program is to use these dynamic models to design brake regulators that will very effectively control the braking effort to maximize the use of available adhesion. It is expected that each vehicle will have a single loop control for each set of wheels, the design of which will take into account the interactive nature of the four brake control loops. The study will also take into account the change in adhesion level, for which connections between controllers on different vehicles are expected to become important.

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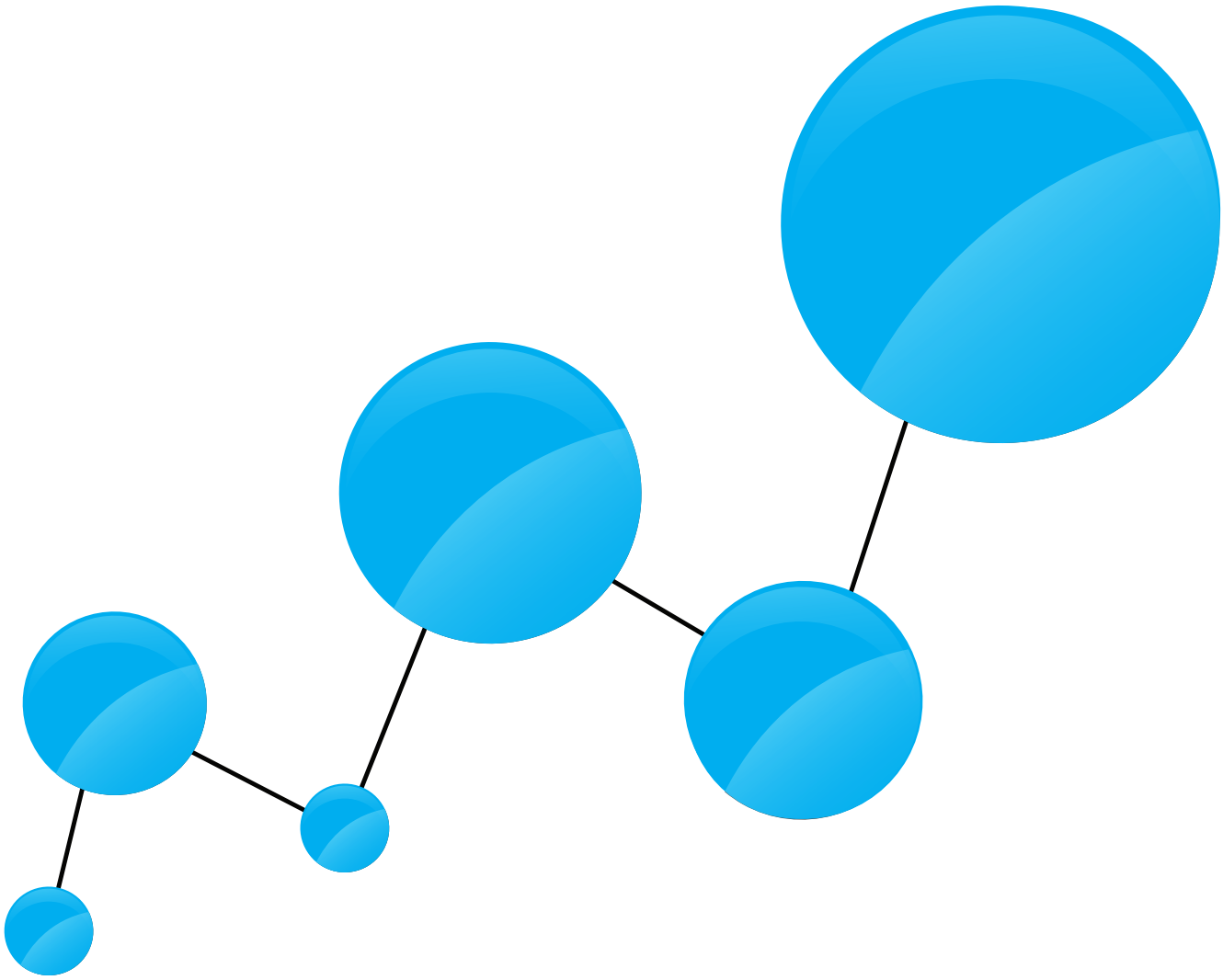

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