Composite Materials Behavior Analyze for Desk, Hull and Board Yacht's Panel

Mirela Koci

University "Ismail Qemali", Faculty of Technical Science
Engineering and Technology Science Department

Abstract

Materials science and composite technology are advancing rapidly, and new composites such as epoxy mixtures including the application of carbon nano tubes are becoming more popular with ever growing concern for high performance marine structures. Indeed, lightness, ease of production, durability and strength enable composites to play a vital role in marine applications. As the Marine sector continues to look at improving efficiency and reducing overall costs, Composite materials will play a huge part in the future of Marine construction. The paper is focused to the static linear simulation of elastic bodies using Solid Works Simulation. Stresses analyses have been developed in the static analyze which provide tools for the linear stress analysis of parts and assemblies loaded by static loads, taking in consideration for the analyze the most stressed part of the bottom, board and desk of the yachts

Keywords: Static analyze, stress, composite materials, optimization, marine sector, leisure yachts.

Introduction

Tourism, as a priority sector for our country, is foreseen to develop and expand in the future. This will also be accompanied by the growth of alternative entertainment capacities, especially with the expansion of the use of yacht type vehicles or other smaller types. Under these conditions, this sector requires the attention of state structures and private operators themselves to advance the overall development of the tourism sector.

Creating the production and repair capacities of these tools is considered a necessity, which, on the other hand, also creates the appropriate structures. But that is not enough. In the production of recreational navigation tools, new concepts should be introduced that relate to the cost of their production, but also to the level of maintenance, or the improvement of comfort, safety standards in the navigation, etc.

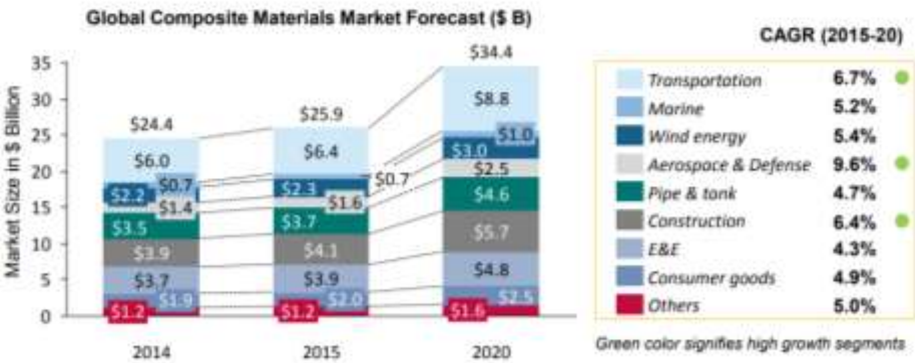
One of the key factors that directly affects these indicators is the type of material used for production.

The global composite materials market is estimated at $ 24.4 billion in 2014 and is projected to reach 5.8% growth and is expected to grow at 5.8% in the next five years, reaching 34.4 billion in 2020

- According to the data of last year industrial production results respectively:
- Glass fibers: 250,000 tons
- Carbon fibers: 30,000 tons
- Natural fibers: 40,000 tons
- Compared to:
- Steel: 800,000,000 tons
- Polymers: 120,000,000 tons

Although production figures with traditional materials and polymers prevail, there is a clear growth trend for industrial production with composite materials especially natural because they have lower costs.

If we analyze the sectors of the use of composite materials we conclude that thermoplastic matrix composites now account for 8% (37% of the production market) - closed casting (RTM, RTM, infusions): 13% of annual output (10% of the EU manufacturing market) - Aeronautical structures: + 11% of annual output. - wind power composition: +16% annual output, composite for the marine industry 4% of annual output.



Composite materials that have started to be used in the production of tourist sailing yachts, especially those of the yacht type, have proven in practice the designers' expectations for the great advantages they have brought compared to steel.

The new generation performance of this millennium will require the ever-increasing use of innovative and innovative materials to meet and meet the growing demand of potential buyers of these vehicles.

On the other hand, based on the principles already sanctioned by the European Community for respecting the norms set for CO2 emissions from shipping - in accordance with the Kyoto Protocol on Climate Change, the production of marine means that reduces in significantly reducing the weight of marine vehicles, resulting in engine power and fuel consumption by significantly reducing CO2 emissions. This alongside the innovation that accompanies the production of engines used with marine vehicles.

Presentation of the Problem

1. For the realization of this study, consideration shall be given to the influence of material on the characteristics of yachts, as the material affects both the production process and the utilization of these vehicles. The impact of the material is significant in terms of weight, vehicle stability and the evolution of forms for the fulfillment of hydrodynamic characteristics. It affects respectively:

- **Weight**

Design trends and Yahti shipbuilding trends are those of realizing the final product with a total dislocation as small as possible. Based on Archimedes law, minimal deployment means the minimum diving volume of the vehicle, which, on the other hand, affects a lesser resistance to movement; Hidrodynamic features with a reduction of the surface area (in the case of sailing yachts), or motor power installed in the case of motor yachts; a better ride comfort; reduction of construction costs and vehicle utilization; increased navigation autonomy, especially in the case of large-dimension vehicles.

Vehicle stability

If we look at the evolution of Yahti's seasonal shapes, and especially the mega yachts with engines, we would point out that in these types of vehicles we have an ever-increasing tendency to utilize vertical spaces, thus providing a greater number of large envelopes in the interim part of the ship. The choice of material for these types of structures is of importance. This is because, as is known from the theory of hydrostatics and stability of the ship, the addition of such ridges means a tendency to shift the center gravity of the ship from above. This, in turn, affects the deterioration of the ship's stability characteristics as well as the problems associated with the longitudinal and wide swing of these vehicles, which means lowering the performance of these vehicles in terms of navigation and comfort.

Evolution of forms and fulfillment of hydrodynamic characteristics

The technological evolution of yacht type shapes has shown that one of the design solutions that satisfies their fulfillment is also the multi-hull marine. They are characterized by the fact that they have a central long jaw center jaw, which is characterized by a slight resistance to movement, as well as a more balanced dispersion of moments at the time of transition to the waveform formed in the sea.

And the side skirts are of a smaller size to provide the vehicle with a better stability and an interference with the value systems created during the movement.

Even in this case, the choice of construction material is of particular importance for these types of tools, which should be as light and easy to handle, in order to achieve optimal forms from the hydrodynamic point of view

Methodology

The study methodology includes the analysis of the laminates of board, deck and hull / yacht through their behavioral assessment under the static load operation using simulations in Solid Work software.

Laminate composition, orientation and its behavior under different pressures needs to be taken in consideration

Laminate and its components

An isotropic material has a uniform set of parameters in all directions. The measured parameters of an isotropic material are independent of the test axes. Metals such as aluminum, titanium etc. are examples of isotropic materials. Fiber is the composite load carrying member. The composite material is strong and solid in terms of fibers. Generally speaking, compositions have predominant mechanical parameters in one direction and are said to be isotropic, having physical / mechanical parameters that vary with the relative directions of the natural reference axes not separated from the material.

Characteristics of the force. Structural parameters such as rigidity, dimensional stability, and strength of a composite laminate depend on the time of assembly of the layers. The assembly sequence describes the distribution of orientation layers along the thickness of the laminate. Since the number of layers with the chosen orientation increases, more assemblies are possible. For example, a 8-layer symmetrical laminate with four different orientations has 24 assembly possibilities.

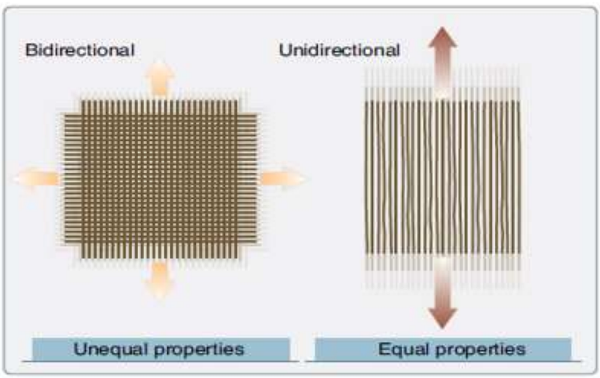


Fig. No 1 – The parameters of one and two directions materials

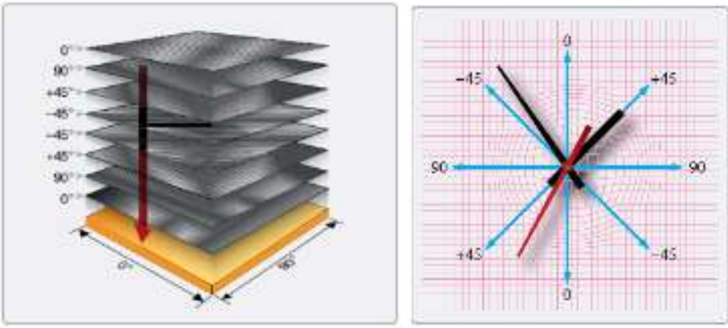


Fig N0 2 – 3 – Lay out of quasi isotropic materials

The fibers in a two-way material move in two directions typically 90 ° each. A simple factory weave is an example of two-way orientation. The oriented layer has loads in both directions but not necessarily at the same value. Isotropic quotients are between 0 °, -45 °, 45 °, and 90 ° or 0 °, -60 °, 60 ° This type of orientation simulates the parameters of an isotropic material.

Simulation follows the following steps:

1. Geometrical design of panels loaded with the end of the boot, its board and its desk. This process is carried out based on the geometrical plot of the ship in the full size of the bin as well as the model dimensions of the panel. They will, for example, be carried out for Panel 4 at the end of the deck, panel 3 for the board and panel 5 for the deck.

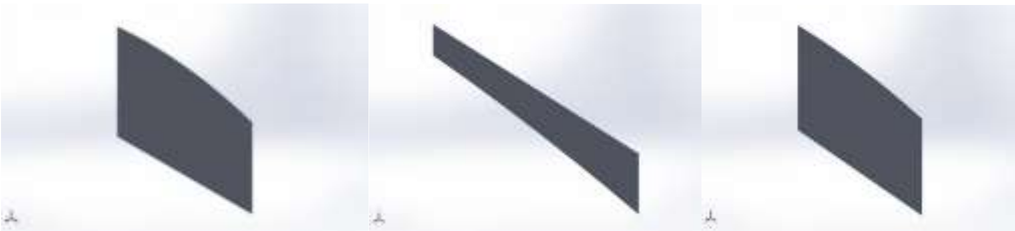


Fig No 4 – Geometric modeling of the board, desk and hull of yacht

2. Establish a static study to determine the degree of deformation of laminate under the action of static loads for laminates produced from different resin and reinforcement materials.

Fig No 5 – Static study for the board panel.

3. Selection of the composite study process, which is performed by selecting from the library of polymer materials, plastic, metal, light alloy containing the software or producing the specific material based on symmetric or layered layer combinations in accordance with the scheme described for the laminate

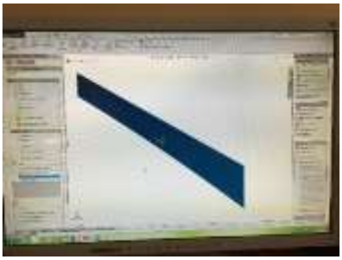


Fig Nr 6 – The study of composite material for the desk panel and modeling.

Fig Nr 7 – Composite material selection for desk panel.

4. Modeling of the material and its placement according to the process layers which is carried out through the softening by placing the thickness of the layers according to the preliminary determination of the total thickness of the layers as well as the orientation of the layers according to the angles respectively 0, 45, -45.0 as described in the laminate scheme.

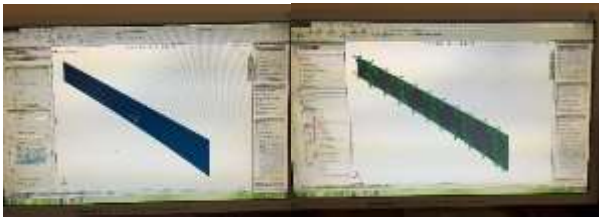


Fig Nr 8 – Fixing and loading the maximal pressure

5. Fixing and loading which is done by making the geometric fixing of the panel according to the ribs and surfaces since we have its static study. The pressure we choose to exert on the surface is the maximum pressure calculated for the hydrostatic load of the waves in a marine environment above 4 Beaufort.

Mesh and Run

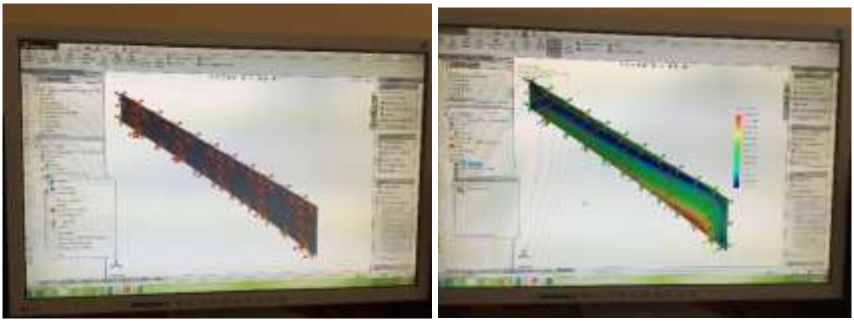


Fig Nr 9 – Mesh and Run

Panel Analysis 4 - Skafi

The following table presents the data of selected materials from 15 simulation samples for each of the parts of the boat / yacht from which only 5 materials were selected which satisfied the preliminary conditions of the study.

Thickness of layers of symmetrical composite materials is the same for all composite composite materials respectively 13.74 mm. The value of the pressure applied in the normal direction with the panel surface is the maximum value of the pressure on panel 4, the panel with the charge (see final draft of the vessel) defined by the table below:

	Panel				
	2	4	6	8	10
Pressure on panel	40,21208	39,25379	30,515535	42,8477	73,93265

Table 1. The panel with the charge

The study is static as panels are stacked in a static state. For panel No. 4, the last loaded boat / yacht panel was also performed with 10 additional simulations with sandwich type composite materials and from them were selected 4 materials whose reports satisfied the conditions pre-set for weight, deformation and strain tensions.

N0	Composite material	Weight (kg)	Thickness (mm)	Tension in the perpendicular N/m2	Displacement (mm)	Stress and elongation ratio	Deformation
1	Rezine& Natural Rubber	17.59	13.74	1.011e+007	2.125	3.14	0.64
2	Custom	18.4	13.76	9.599e+00	1.691	2.39	0.8

	Plastic&Rubber			7			
3	Epoxy &Rubber	18.37	13.74	9.786e+007	1.701	2.563	0.8
4.	Polyester rezin& Natural rubber	18.65	13.74	1.14e+007	2.463	3.711	5.52
5	PVC&natural rubber	18.75	13.74	9.786e+007	1.701	2.563	0.8

Tab N0 2 . The table of simulation data for the panel No4 of the skaf board

From the table we find that if we refer to the panel size 4 for the same thickness of the layered material, symmetrical with a combination of two materials (base + reinforcement), the composite material with layer Rezine + Natural Rrubber has the lowest mass for panel 4, panel with loaded. Since constructive calculations are performed by taking the most loaded panel parameters, then the mass of the last part of the boat / yacht with the Rezine + Natural Rubber material is smaller compared to the other materials. This material also gives the best performance in terms of voltage on the perforation because of the 5 materials selected on the basis of the generated ratio Rezine + Natural Rubber has the lowest voltage in the curve of 1.011e + 007 N / m2 as a result the lowest deformation 0.64.

Comparable with it is the composite material with a custom plastic + rubber layer which has a little bit more weight than the Rezine + Natural Rubber material, but has better indication of panel displacement in mm due to maximum pressure action and stress-strain ratio. But at the same time this material has higher deformation than the selected material.

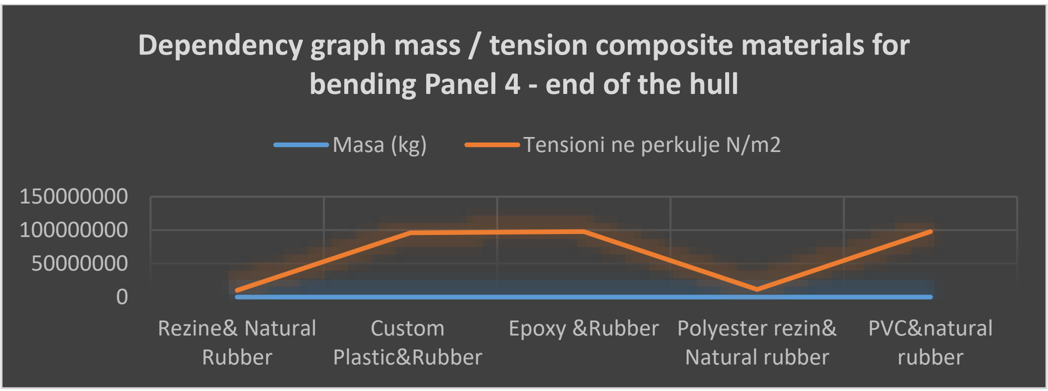


Fig N0 9 – Dependence / tension strain chart for composite materials Panel 4

In Fig. 9, the stress tension of the panel is presented with various composite materials from its mass where the Resin + Natural Rubber and Polyester Rezin & Natural

Rubber materials have low stress tension values and both materials can be taken consider whether we would only refer to this parameter.

But if we take into account other parameters, the displacement, stress / strain ratio and deformation have a different view of composite materials that meet these requirements. This comparison is found in the graph below Fig. No 10

This graph clearly shows that Rezine + Natural Rubber material satisfies well the requirements of the study, especially those related to mass, displacement and deformation in relation to four other simulated composite materials

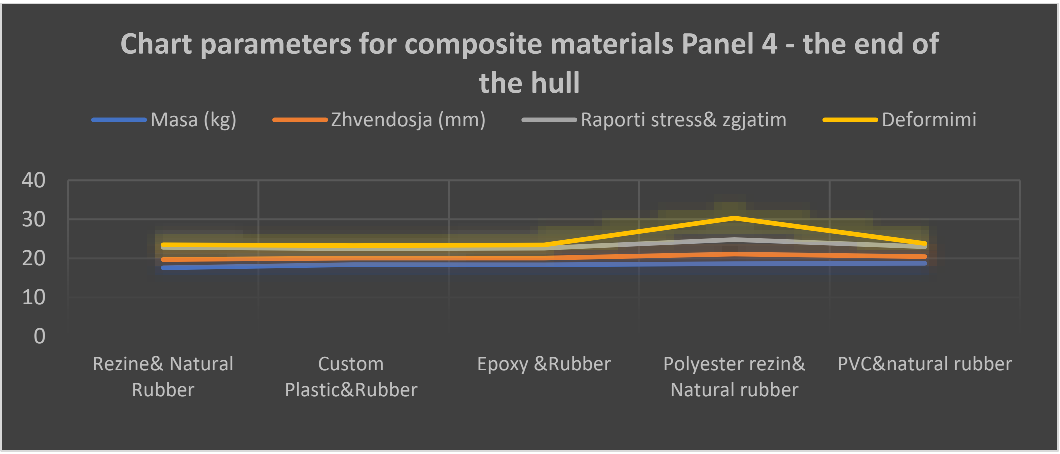


Fig No 10 – Chart parameters for composite materials Panel 4

The Custom Plastic + Natural Rubber composite follows the above material and can be considered as a suitable composite material for the final production of the shoe, but if we compare its parameters with the parameters of the Rezine + Natural Rubber material as it shows Fig. No. 110 shows the advantage of the second material to the first.

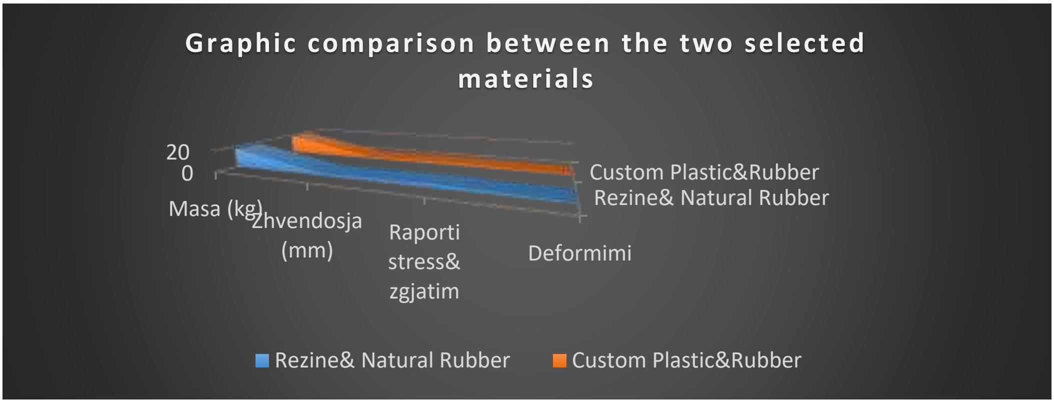


Fig No 11 – Graphic comparison between the two selected materials

Conclusions

Design of marine vehicles according to ISO standards is based on the design of marine tools with software applications. Any conclusions from the analysis of computer software shows what standards have foreseen in the methodology of calculation.

The study confirmed that the calculation of the paneled loading material for the end, the board and the deck of the ship with the ISO standard and with the software application are almost similar to a very small error tolerance ascertained in the overall thickness of the layers of composite marbles with layers.

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