CAD GEOMETRIC MODELLING SOFTWARE, USEFUL TOOLS FOR HULL DEVELOPMENT AND NAVAL ARCHITECTURE CALCULATIONS OF ALBANIAN MARINE VEHICLES.

BLENARD XHAFERAJ , PHD

(Lecturer of Naval Architecture, and Ship Design)

MAIN AIM

The paper aims to demonstrate the efficacy of CAD/CAE software and geometric modelling techniques as essential tools for hull development and naval architecture calculations of Albanian Marine Vehicles.

MOTIVATION

- Development of hull form has a significant impact on project evaluations, performance analyses, and ship building process.
- Traditionally, naval architects use the so-called lines plan to represent the hull form of a ship.
- Different manual techniques and methodologies can be used to develop this plan.
- Based on the developed hull form, naval architects perform necessary calculations and verifications, such as hydrostatic, stability, and hydrodynamic calculations.
- However, traditional manual methods are tedious, time-consuming, and prone to errors.
- Nowadays, geometric modelling techniques and CAD software are modern tools that can help naval architects to perform accurate calculations by minimizing the time needed for calculations.

MOTIVATION

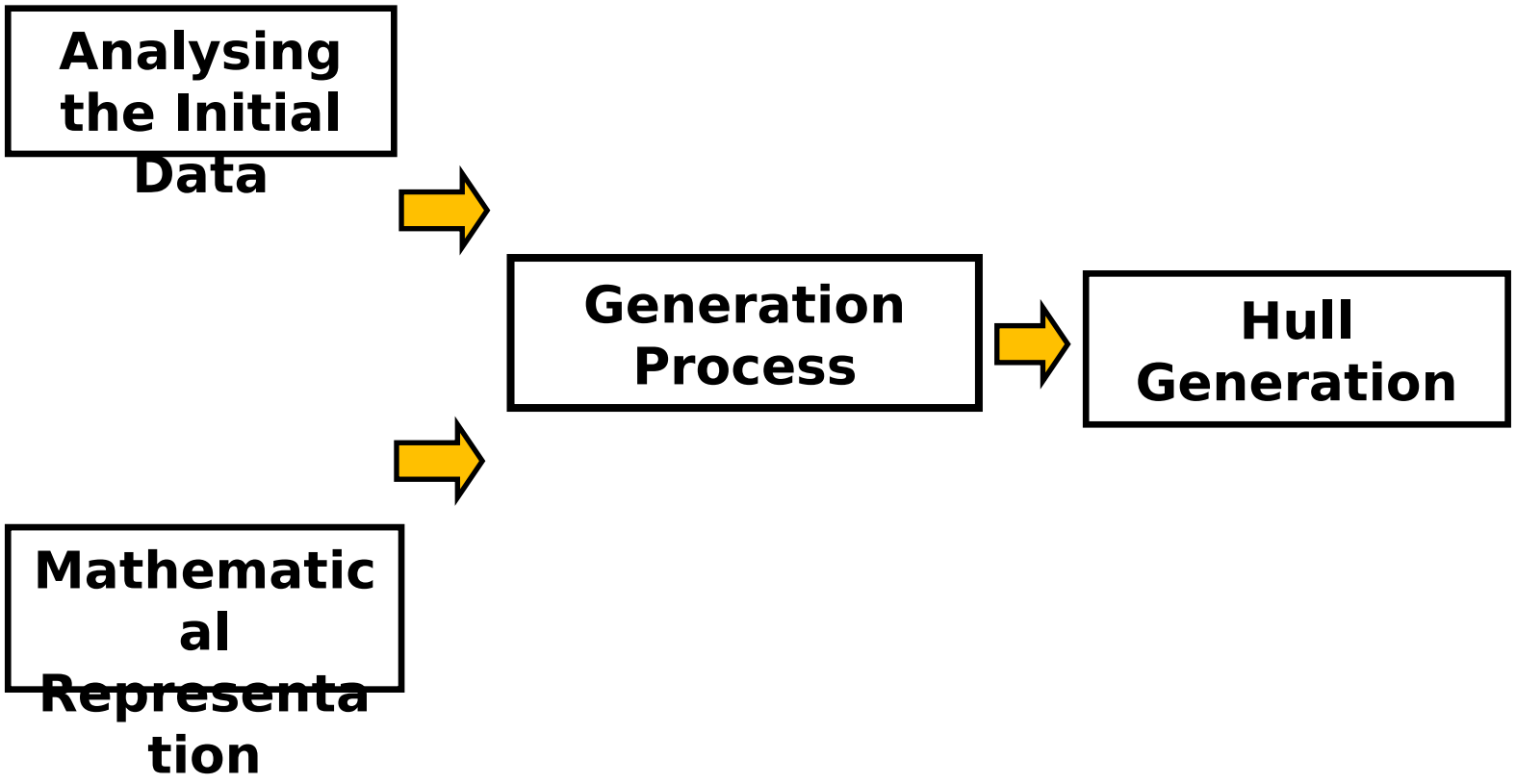
- Specialised literature Nowacki, (2010) [3], has highlighted the following motivations for the use of CAD application in ship design:
  - the need for digital information for automation of manufacturing process.
  - the desire for digital representation of the geometry of the ship, in order to replace the traditional ship lines definition.
  - the need for application of computers for time-consuming tasks of ship design calculations, such as ship stability, hydrodynamic, and structural analysis.
- Albania is a small country, with a modest development of the maritime Industry.
- The design and construction of ships in Albania are mainly based on traditional methods and practical experiences [4].

MOTIVATION

- In addition, the country lacks the necessary human and technical professional capability to respond to the actual challenges that face the shipbuilding and boatbuilding industry, which is characterized by a high level of competitiveness and internationalization.
- The country also lacks the necessary tools, to perform experimental tests relating to the definition of resistance and propulsion test.
- The use of computer software packages CAD/CAM/CAE can help overcome some of the challenges faced by the shipbuilding and boatbuilding industry in Albania.

MAIN ELEMENTS NEEDED FOR HULL DEVELOPEMENT PROCESS

- Geometric modelling techniques can be applied to all methods of ship line plan development.
- The following elements need to be adreessed for the generation of the hull form



MAIN ELEMENTS NEEDED FOR HULL DEVELOPEMENT PROCESS

- **Analysing the Initial Data**

  The initial data refers to the main data of the ship and any other information about the main section of the hull.

- **Mathematical Representation**

  The predominant mathematical functions used by CAD modellers in hull form definition include curves and surfaces such as:

  - **B-Spline**
  - **Bezier**
  - **NURBS (Non-Uniform Rational B-Splines)**

- **NURBS are used for this study**

FLOW CHART FOR HULL DEVELOPMENT AND USE OF CAD/CAE SOFTWARE

- **The generation process involves creating a basic flowchart for modelling the hull in the selected CAD software.**

FLOW CHART FOR HULL DEVELOPMENT AND USE OF CAD/CAE SOFTWARE

- Based on the previous experience of the author, the MAXSURF Modeller software was choosen for modelling purposes.
- This software is widely used by naval architects worldwide and has the capability to exchange information with other software within the MAXSURF packages, such as Maxsurf Stability and Maxsurf Resistance
- Furthermore, the software can also exchange information with other software, like CFD or CAM software, and has a user-friendly GUI (Graphical User Interface). The software has the capability to generate B-Spline, NURBS, Conic and developable surfaces.

CASE STUDY FOR HULL DEVELOPMENT AND NAVAL ARCHITECTURE CALCULATIONS IN CAD/CAE SOFTWARE

- The flowchart presented in the previous section was used to generate the hull of a small marine vehicle, having characteristics as presented in the fowing table.

Main Characteristics	
Length overall, L_{MAX} (m)	8.125
Beam, B (m)	1.78
Forward Draft, T_F (m)	0.42
Stern Draft, T_A (m)	0.42

- The objective was to develop a hull with an overall similarity with the NPL systematic series of hulls.

CASE STUDY FOR HULL DEVELOPMENT AND NAVAL ARCHITECTURE CALCULATIONS IN CAD/CAE SOFTWARE

- Figures 2 and 3 represent the rendered hull form and the line plans of the boat.

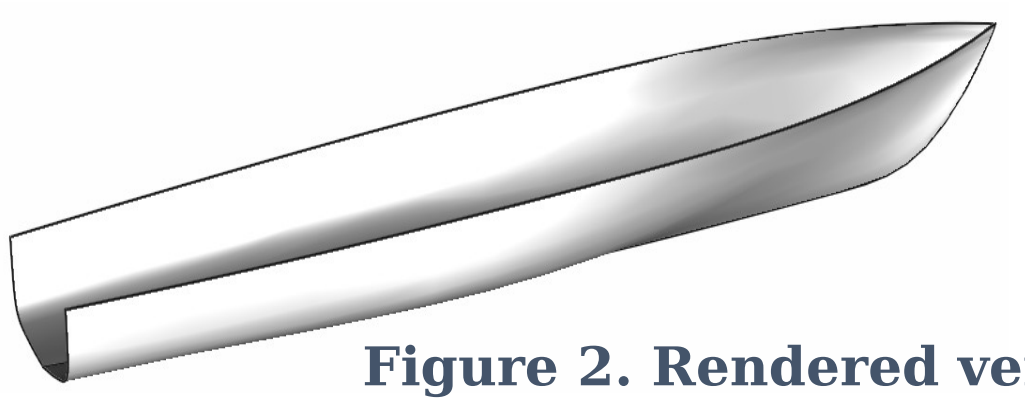


Figure 2. Rendered version of the hull.

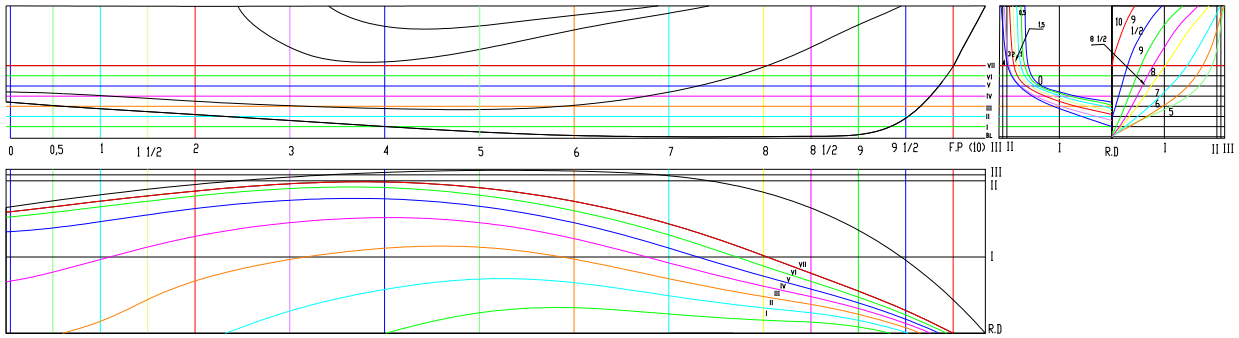


Figure 3. Lines plan of the hull

CASE STUDY FOR HULL DEVELOPMENT AND NAVAL ARCHITECTURE CALCULATIONS IN CAD/CAE SOFTWARE

- **The hull is converted in IGES file and was further processed in Maxurf Stability, and Maxsurf Resistance to obtain the hydrostatic and resistance characteristics of the boat.**

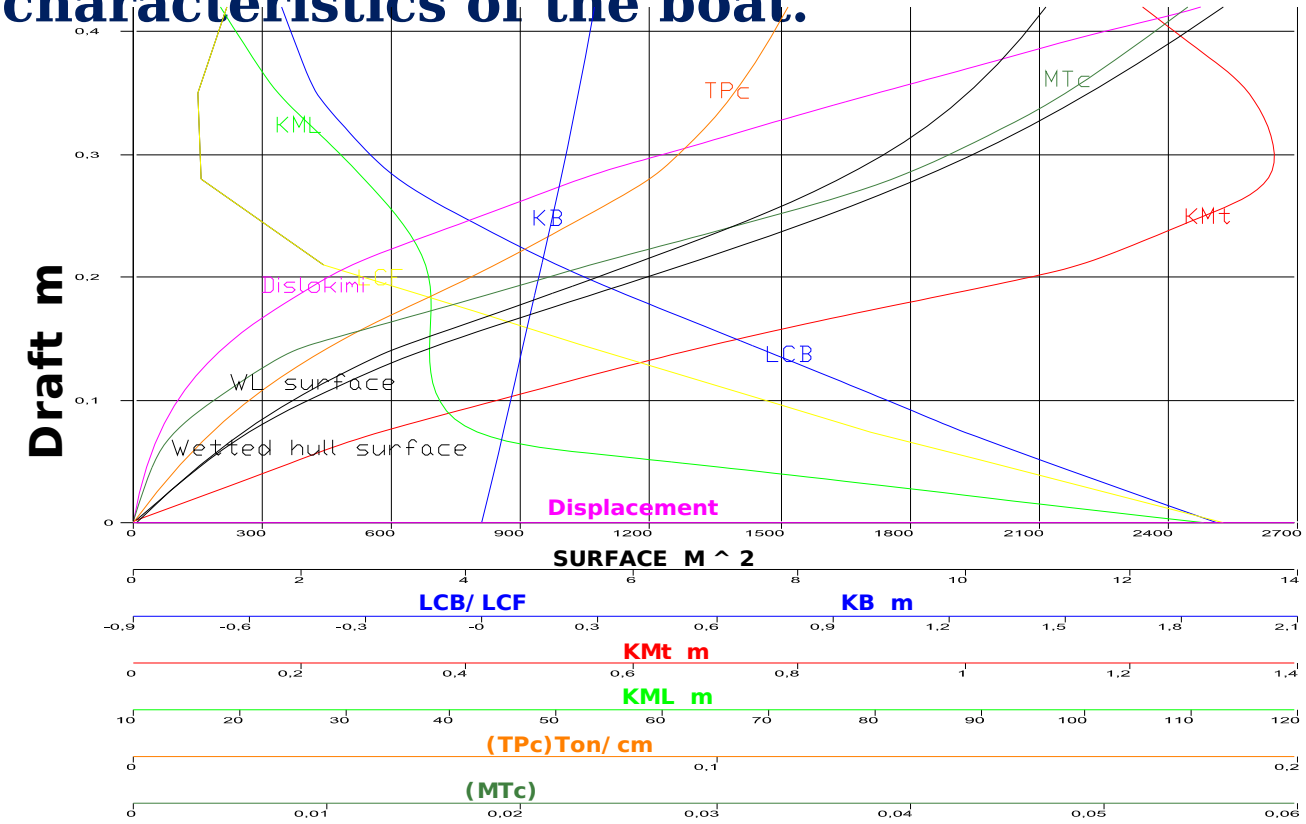


Figure 4. Hydrostatic curves

CASE STUDY FOR HULL DEVELOPMENT AND NAVAL ARCHITECTURE CALCULATIONS IN CAD/CAE SOFTWARE

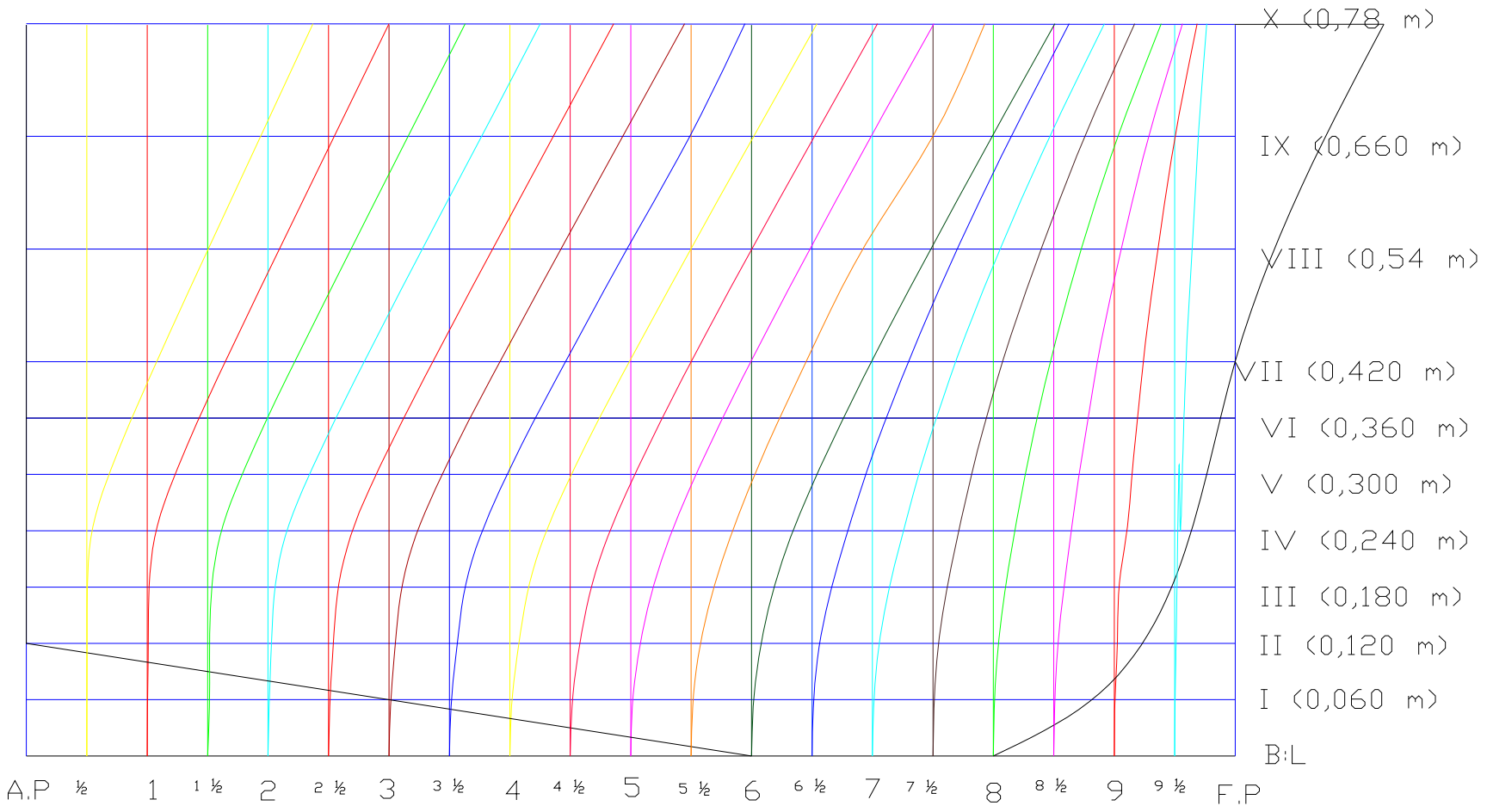


Figure 5. Bonjean Diagram

CASE STUDY FOR HULL DEVELOPMENT AND NAVAL ARCHITECTURE CALCULATIONS IN CAD/CAE SOFTWARE

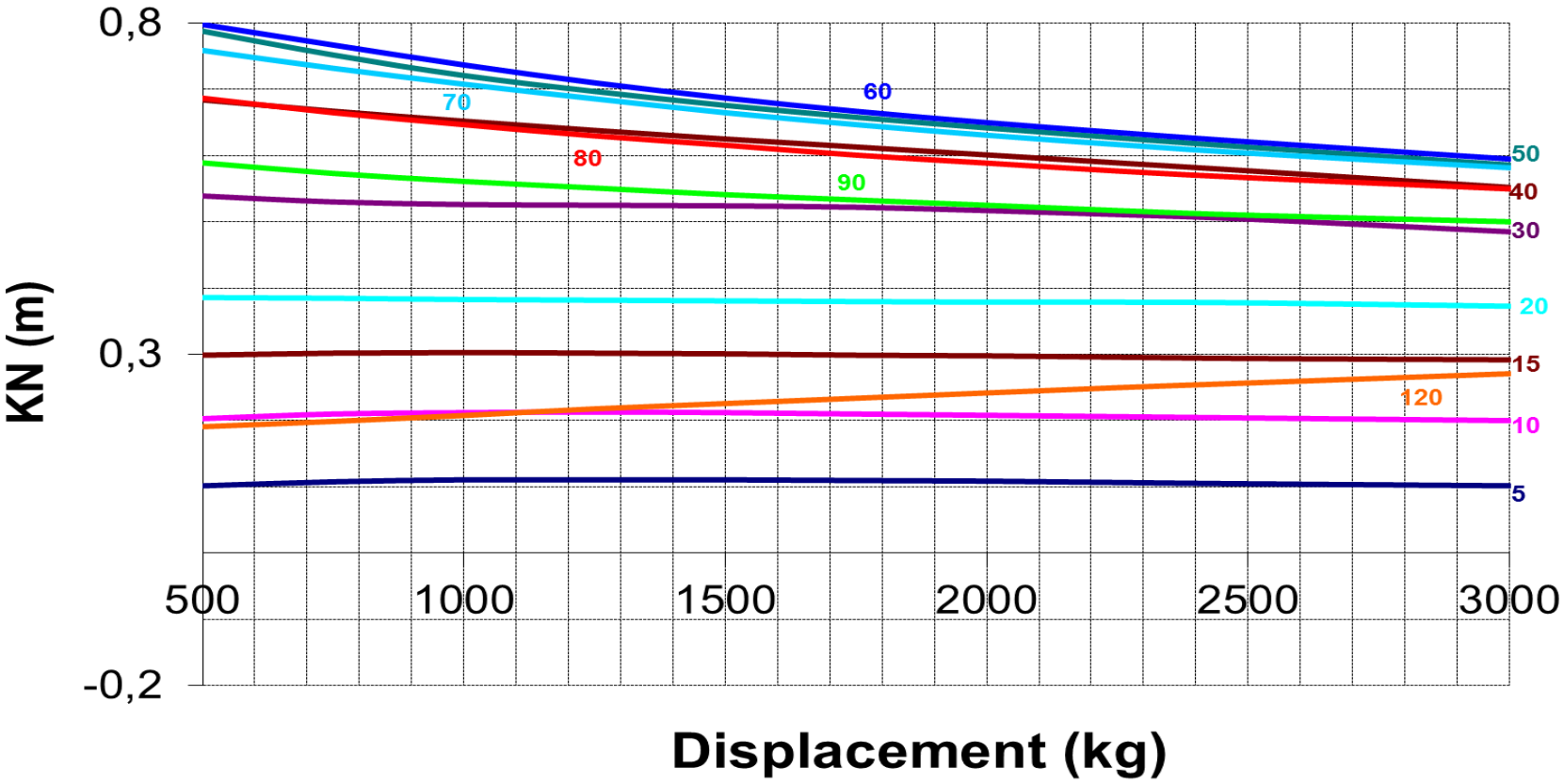


Figure 6. Curve of stability of form

CASE STUDY FOR HULL DEVELOPEMENT AND NAVAL ARCHITECTURE CALCULATIONS IN CAD/CAE SOFTWARE

- The generated hull was also processed in Maxsurf Resistance to obtain resistance and power predictions.
- Fung and Holtrop models of regression were considered to perform the calculations.
- Results of calculations were obtained for speeds from 1 to 14 knots, corresponding to Froude numbers 0.14 up to 0.8.
- Graphical representations of resistance and power are presented in Figures 7 and 8.

CASE STUDY FOR HULL DEVELOPMENT AND NAVAL ARCHITECTURE CALCULATIONS IN CAD/CAE SOFTWARE

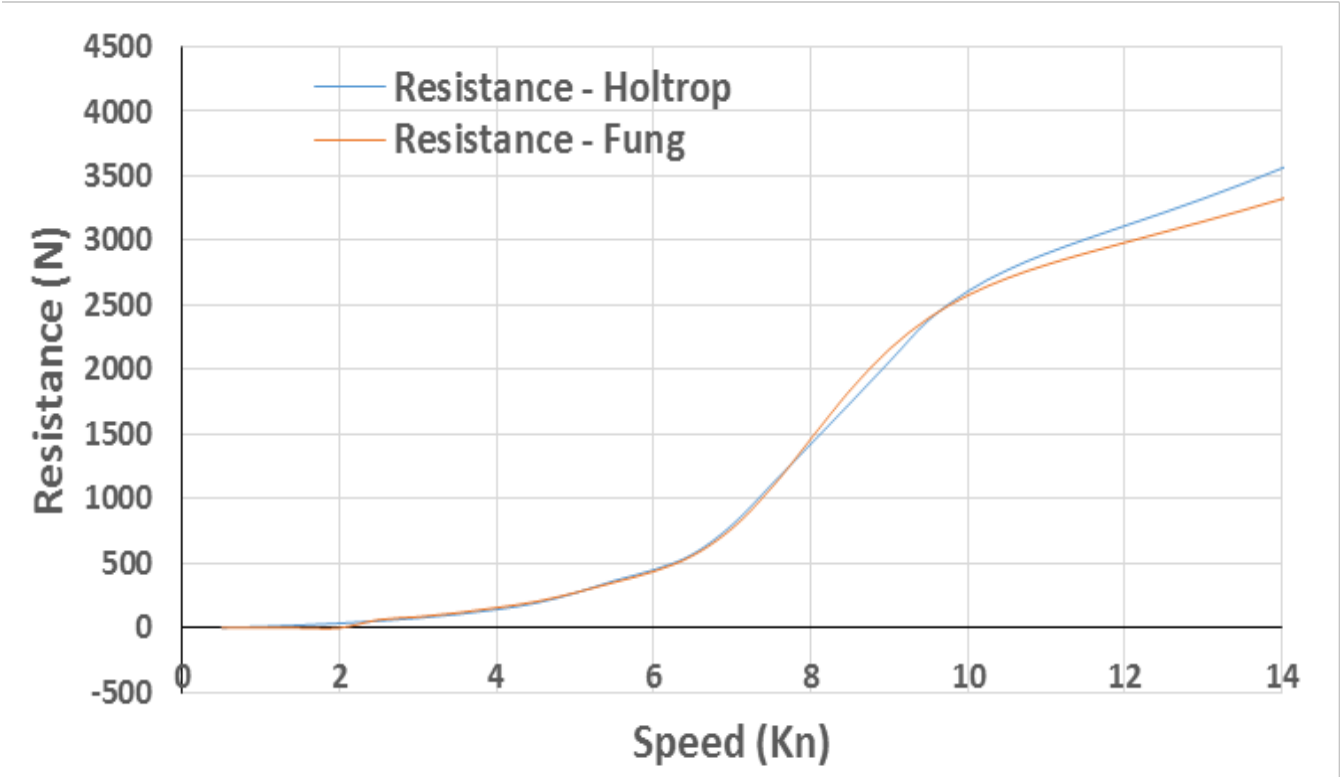


Figure 7. Graph of Resistance versus speed

CASE STUDY FOR HULL DEVELOPMENT AND NAVAL ARCHITECTURE CALCULATIONS IN CAD/CAE SOFTWARE

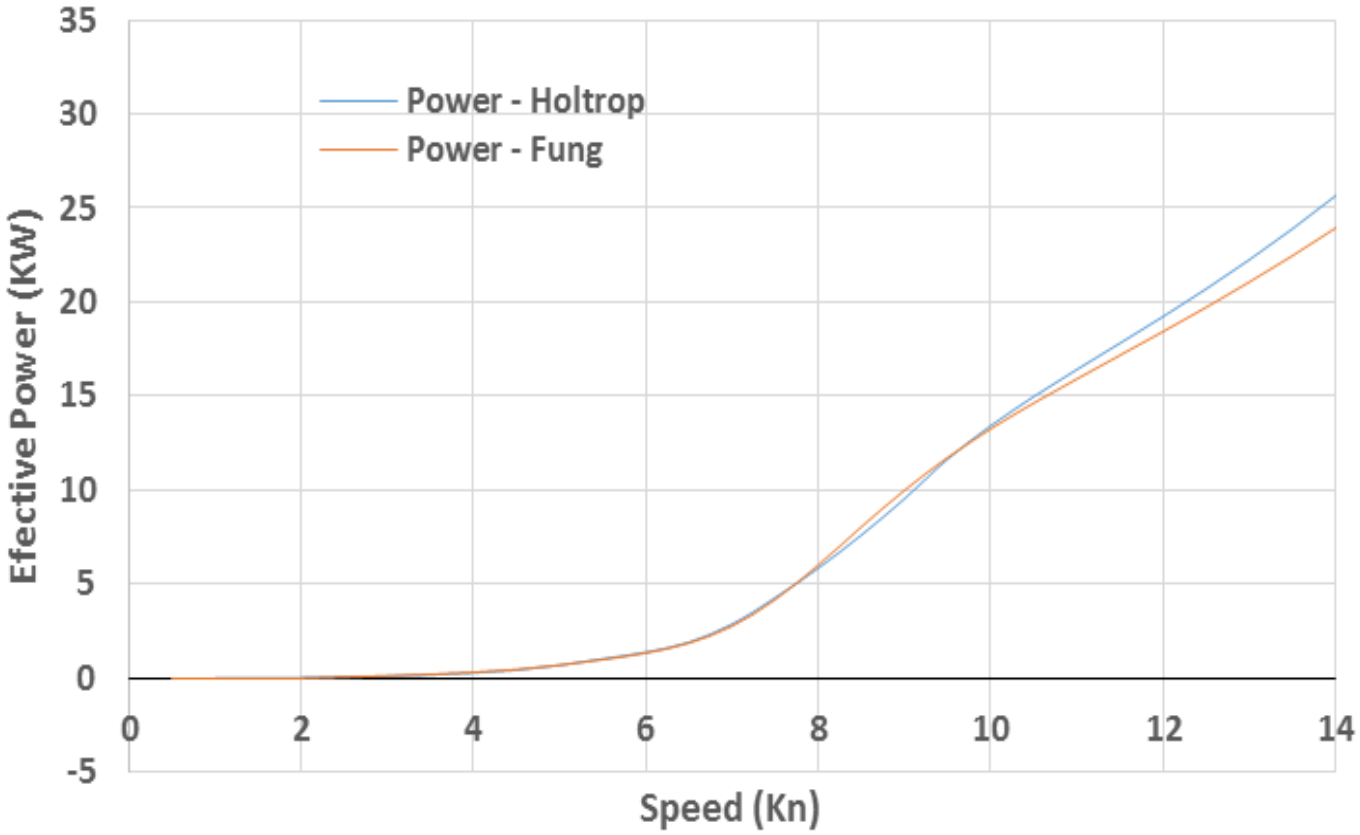


Figure 8. Graph of Effective Power versus speed

CONCLUSIONS

- In this presantation a methodology of applying CAD-CAE application for the development of hull and performing the hydrostatic and resistance characteristics of Albanian marine vessels.
- By applying these tools the navigational performance of the hull of ships can be evaluated quickly and accurately.
- In this study, the calculation of resistance and power were obtained based on regression models. In conventional hull forms and for geometrical characteristics of the hull within the limits of applications of the regression models, the obtained results of calculations can be reasonably accurate.
- CFD tools can also be used for a better accuracy of prediction of resistance.
- The methodology can be used to other Albanian ships that luck the information about hydrostatic and resistance charcteristics.

Thank You for Your Attention