Chapter

Prologue: Exploring the Potential of the Sea

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1. Naval engineering

Naval engineering is the branch of engineering that has as main activity the exploration of the potential of the sea. Although specialized, naval engineering is quite eclectic since it addresses the main aspects of other engineering modalities, directly or indirectly. With the development of oil exploration and production in the ocean, the naval engineer's work extended to ocean engineering.

The naval engineer is engaged in all stages of life of vehicles and platforms for maritime transport, the exploitation of marine resources and recreational activities, from the concept and design phase, to the construction phase and its quality control, through inspection, maintenance and repair. Also included are maritime and port operations planning and management tasks. The professional must have the systemic and comprehensive vision necessary for the design of large engineering systems.

Appealing to the wide-ranging aspect of naval engineering, the engineer also deals with the design, construction, repair and logistics of inland waterways used for inland transportation.

2. Fields of intervention

The fields of intervention of the Naval Engineer are quite broad, concerning design, construction, modification, repair, maintenance and dismantling of ships, vessels, other maritime vehicles and floating structures [1].

In the project phase, the Naval Engineer has overall technical responsibility, including safety and pollution prevention, as well as aspects related to the nautical and operational qualities of the ship, as well as the ergonomic and automation aspects. In these areas, the Naval Engineer performs calculations in the various technical areas of his specialty, acts as systems integrator on the ship and as coordinator of multidisciplinary teams made up of engineers and other professionals who deal with the numerous sectoral aspects [1].

In the industrial activity of construction, modification, repair and dismantling of ships, the Naval Engineer acts either as a production or project manager or as a specialist in the planning of production and in the definition of constructive strategies and operational solutions. In this context, it also carries out docking and launching calculations, defines and directs the stability test, performs its calculations and defines and directs the tests to the pier and sea [1].

Other fields of intervention of the Naval Engineer include the following [1]:

- Technical, commercial and maintenance management;
- Management and planning of maritime operations and the maritime-port interface;
- Development and application (approval, survey and inspection) of rules and regulations;
- Consulting and technical advice, as well as expert activity;
- Marketing and technical support of marine systems and equipment;
- Teaching and research.

3. Technical areas

The technical areas of Naval Engineering are the different interdependent areas that allow to carry out the development of the ship project in its entirety, being the following [1]:

- Naval Architecture;
- Statics and Stability;
- Resistance and Propulsion;
- Structural Strength;
- Behaviour at Sea;
- Maneuverability;
- Vibration and Noise.

The Naval Architecture comprises the design of the ship, the development of the general arrangement and a first approximation of the geometric plane, considering both the design requirements and the classification rules and legal regulation applicable. The interior spaces of the ship are allocated to the various functions, contemplating functional requirements, fire and flood protection, escape routes, life-saving appliances, multiple ship systems, navigation and communications equipment and the signaling systems which must be integrated into a functional and coherent general arrangement [1].

In the Static and Stability area, the buoyancy and stability of the ship (intact and damaged) shall be assessed in accordance with the applicable classification rules and legal regulations in order to ensure a safety margin against tipping actions that the ship may encounter in its life: waves, wind, cargo or others [1].

The Strength and Propulsion area consists of the dimensioning of the propulsion system (main machines, reducers, shafts, propellers or other propulsion means) to achieve the design speed, considering the geometric plane, with the highest energy efficiency and minimizing emissions [1].

The Structural Strength area considers the dimensioning of the structure of the ship in all its details, including type of materials and scantlings, considering its general arrangement, in order to ensure the necessary resistance to stress due to waves, cargo or others, considering also the requirements of the applicable classification rules [1].

The Sea Behaviour area consists of studying the movements of the ship under the action of waves, regarding movement amplitudes, accelerations, propeller emersion, bow emersion, water boarding on the deck, in order to assess the operationality of the ship in sea [1].

The area of Maneuverability consists of the study of maneuverability and directional stability of the ship, mainly for maneuverability in confined waters, also considering applicable legal requirements [1].

The area of Vibration and Noise studies the vibration and noise levels in the various on-board spaces, as well as the radiated noise to air or water, determining the measures necessary for their minimization and maintenance within the limits imposed by classification rules or legal regulations [1].

4. Cultural inheritance

The Naval Engineers in Portugal are heirs of a long tradition in shipbuilding, which allowed the Maritime Expansion in the fifteenth and sixteenth centuries. The legacy of some of the men who studied and built ships in Portugal at that time have reached our days: Fernando de Oliveira, João Baptista Lavanha and Manuel Fernandes. The Portuguese Age of Discovery and later maintenance of the regular transport of passengers and goods and maritime safety between the multiple components of the "Portuguese Space" up to the twentieth century are very much in keeping with Portuguese Naval Engineering [1].

The Portuguese Economy of the Sea has shown, over time, great economic and social resilience, being able to grow above the average of the national economy during a period of great economic instability. If investment in the marine industries is strengthened, particularly in terms of external investment, the economy of the sea will be able to progress to higher levels of growth and economic development [2].

Compared with its terrestrial dimension, the maritime geographic dimension of Portugal is enormous. Its location in the North Atlantic, in the west of the European continent, as maritime neighbors of the American and the African continents, and with a history closely linked to the oceanic routes, particularly with the Asian continent, indicates that its geographical position has relevant strategic significance [2].

The recent "rediscovery" of the Economy of the Sea as a source of wealth and resources, mainly with the development of marine renewable energies and with the expansion of the continental shelf, which could potentially contain oil, natural gas and minerals, will certainly pose great challenges and offer new opportunities to Portuguese Naval Engineering in the twenty-first century [1].

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