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ENGINE PROPELLER MATCHING ANALYSIS ON FISHING VESSEL USING INBOARD ENGINE

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Abstract

Fishing vessels which are used for one day operations usually use outboard engines as their driving motor. However, to improve the performance of propulsion systems, and consequently the performance of ships, inboard engines are now being used. In this study, the propulsion system of a ship was modified by upgrading from an outboard to an inboard motor. Meanwhile, the study aims to obtain an optimal interaction between the propulsion system and the hull shape of the ship. It was conducted by calculating the ship's resistance using the van Oortmerssen method, and validating the result using the CFD method. Furthermore, thrust and torque calculations were performed to obtain the characteristics of the ship's propellers, and the results were validated using the CFD method. The result obtained from the calculation of the ship's resistance was a New Fishing Vessel engine power of 11 HP. 4 types of B-Series propellers characterized based on the size of their pitch, including 14.00 inch, 14.25 inch, 14.50 inch, and 14.75 inch were, analyzed using the engine propeller matching analysis. The results show that the propeller with the pitch size of 14.75 inches was the best, as it had a power of 100%, speed of 25.35%, and efficiency of 32%. Therefore, it was chosen as the new propeller for New Fishing Vessels.

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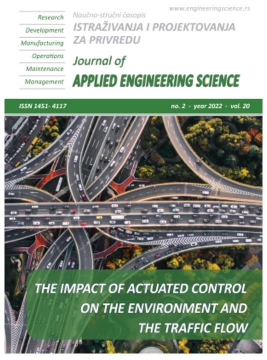

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ENGINE PROPELLER MATCHING ANALYSIS ON FISHING VESSEL USING INBOARD ENGINE

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Fishing vessels which are used for one day operations usually use outboard engines as their driving motor. However, to improve the performance of propulsion systems, and consequently the performance of ships, inboard engines are now being used. In this study, the propulsion system of a ship was modified by upgrading from an outboard to an inboard motor. Meanwhile, the study aims to obtain an optimal interaction between the propulsion system and the hull shape of the ship. It was conducted by calculating the ship's resistance using the van Oortmerssen method, and validating the result using the CFD method. Furthermore, thrust and torque calculations were performed to obtain the characteristics of the ship's propellers, and the results were validated using the CFD method. The result obtained from the calculation of the ship's resistance was a New Fishing Vessel engine power of 11 HP. 4 types of B-Series propellers characterized based on the size of their pitch, including 14.00 inch, 14.25 inch, 14.50 inch, and 14.75 inch were, analyzed using the engine propeller matching analysis. The results show that the propeller with the pitch size of 14.75 inches was the best, as it had a power of 100%, speed of 25.35%, and efficiency of 32%. Therefore, it was chosen as the new propeller for New Fishing Vessels.

Key words: resistance, thrust, torque, engine propeller matching, CFD

INTRODUCTION

A Fishing vessel is one of the common means of transportation used by fishermen to find fish in the sea. Fishermen are one of the main sources of income, especially on the north coast. This shows that fishing boats must have maximum performance in line with the fish catch and operational costs of the fishermen [1]. In theory, the ship gets a restraining force called resistance. This resistance must be countered by the thrust generated by the ship's propulsion system. The ship must have a propulsion system following the shape of the hull of the ship can result in optimal interaction between them, so that the performance of the ship's propulsion system is optimal [2]. Based on the results of field studies, the majority of the propulsion systems on fishing vessel use an outboard engine. In its development, some of the propulsion systems for fishing vessel with one-day fishing operations have used an inboard vessel because it is considered more efficient than using an outboard engine. In this case, fishing vessel usually only use a single propeller, but the size of the propeller varies so that each fishing vessel has a different performance [3]. This can be influenced by the size of the propeller pitch. In the research of the MT.NUSANTARA's ship due to changes in the propulsion system, engine propeller matching was carried out to find the match between power and speed of the main engine and propeller. From the research, it was found that the main engine and propeller had the best match point [4]. Besides, in engine propeller matching research by changing the shape of the hull of the ship, resulting in a new main engine and propeller which is considered to be able to optimize the performance of the drive system [5]. From some of the studies described above, the author wants to do further research on engine propeller matching by changing the shape of the hull, which initially uses an outboard engine to be converted into an inboard engine. This study aims to obtain the optimal propulsion system on the New Fishing Vessel using an inboard engine. The benefit of the research carried out is as a reference in providing information related to the effect of changing the fishing boat drive system with an outboard engine to an inboard engine for those in need.

This research also has the following objectives:

1. Design a new fishing vessel and get the resistance force
2. Perform calculations on the main engine and new propeller
3. Analyzing engine propeller matching for new fishing vessels

METHOD

In this research, to obtain data, direct measurements were made of the two fishing vessels that were examined. The two ships were named the old fishing vessel and new fishing vessel. The dimensions of the two fishing vessels are:

a. Old fishing vessel

- Length Over All (LOA) : 9 m
- Length Between Perpindicular (LPP) : 7.38 m
- Bredth (B) : 1.15 m
- Draft (T) : 0,25 m

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THE IMPACT OF ACTUATED CONTROL ON THE ENVIRONMENT AND THE TRAFFIC FLOW

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In our paper, we have analyzed and compared fixed and actuated control at a chosen intersection, where we pointed out the importance of actuated control and its benefits. We have used traffic data from sensors in the roadway. The intersection was modelled in Aimsun, where we performed simulations. The research focused mainly on the impact of actuated control on the basic characteristics of the traffic flow, delay time and emissions. The outputs of simulations showed positive results of actuated control in all compared values. The environmental pollution topic is up-to-date and road transport has a significant impact on it. Furthermore, we want to continue with our research to investigate the impact of speed changes on emission production and the smoothness of the traffic flow under fixed and actuated control.

Key words: intersection, delay time, emissions, simulation, fixed control, actuated control

INTRODUCTION

Road transport is still the most attractive mode of transportion for majority of the population. The increasing flow of vehicles causes many issues, including congestion of traffic, noise pollution, accidents, longer travel times, etc [1-5]. Road network expansion is slow and often not possible [6]. Therefore, it is necessary to look for other solutions to ensure smooth and sustainable transport. A major problem of the road network is intersections - points where several traffic flows meet [7,8]. It is vital to enable actuated control (intelligent traffic management) at signal-controlled intersections, which will allow the maximum number to pass through and reduce the delay time. There are several ways to solve the well-known traffic issues within cities. Increasing preference for public transport is the first solution to current traffic issues. This preference means prioritizing public transport over individual automobile transport (IAT). For example, it is the preference at signal-controlled intersections or in the form of traffic signs (bus lane). However, this does not solve the problem with the growth of vehicle convoys, [9,10]. On the other hand, if more people were willing to switch to public transport from IAT, traffic becomes smoother (the volume of emissions produced will decrease as a direct result of the reduction of vehicles on the road) [11-13]. The preference is necessary to ensure the attractiveness of public transport [14]. Also, electrification is an important way to increase the attractivity of public transport and reduce its negative impact on the environment [15,16]. In addition to public transport, it is necessary to build and maintain infrastructure for pedestrians and cyclists since they help reduce the number of vehicles [17]. The second way to solve the problem is widening roads (both increasing the number of lanes as well as building new roads), building multi-level intersections and city bypasses that divert transit traffic outside the central part of cities or outside cities in general [18,19]. Though this is an effective solution because it is a very expensive one it is often viewed as unfeasible [6,20]. The third way is dynamic optimization of traffic management (actuated control). For example, enforcing a control system using light signalling devices at intersections. Traffic management is the crucial way for the efficient managing of transport at intersections and roads in cities [22]. Actuated control is an effective way to manage intersections in many parts of the world [23-26].

"The key to ensuring the effectiveness of actuated control lies in the capability of timely updating the signal timing parameters responding to actual arrivals at entrances of the intersection. Conventionally, this can be achieved by adjusting actuated control parameters" [21]. These parameters include adjusting maximum pedestrian waiting times, cycle length, gap times, detector locations and minimum/maximum green time [27,28]. On one hand, there are various principles when optimizing traffic signal timing by combining data from connected vehicles on the loop detector data [29], using trajectory data of the connected vehicle [30], the floating car data [31]. However, there are not enough connected vehicles in real-time traffic to collect adequate traffic data. Currently, it is possible to gather real-time data on urban traffic via sensors, detectors or mobile apps [32,33,6]. This data along with calculation methods can assist in significantly improving the dynamic of traffic management [34-41]. Various intelligent traffic solutions are advancing in the world. These include intelligent transport systems and traffic management data, which use the Internet of Things to improve transport and thus provide higher living standards to its people [42]. The study in Thessaloniki describes the integration of an intelligent transport system (ITS) "in urban mobility management with an achieved goal of balanced ("sustainably smart") use of transport networks, in compliance with the principles of sustainable urban mobility" [43]. Artificial intelligence is a way to manage traffic efficiently to ensure smooth traffic flow. At present,

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NUMERICAL EVALUATION OF SEISMIC PERFORMANCE OF CORRUGATED-PLATE SHAPED STEEL TUBES

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The current work presents a unique study on the seismic performance of innovative corrugated-plate steel bridge piers. While several previous research was conducted on steel tubes with cross sections such as rounded or semi triangular plates, the seismic performance of such structural members with straight ribbed corrugation geometry under uniaxial cyclic loading remained a research gap. Thus, this research aims to present a new concept that could add a promising design to steel tubes under seismic effect. The seismic performance of such piers was numerically investigated in terms of the load-bearing capacity and local buckling. ABAQUS was employed to accomplish a series of finite element analyses on corrugated-plate steel bridge piers under constant axial dead load and lateral cyclic displacement. Three different geometries of corrugated-shaped steel tubes (i.e., C60, C80, and C146 mm deep) along with four different thicknesses (i.e., 6, 8, 10, and 12 mm) were investigated and compared to the traditional circular-shaped steel tubes (i.e., Cir) having same thicknesses and outer diameter. The results revealed that the innovative corrugated-plate steel bridge piers offered 20% greater load-bearing capacity and 66% more ductility compared to their companions of circular-shaped steel tubes. It was interesting to notice that the peak value of the load-bearing capacity of the C146 column was greater than those of the C80 and C60 columns by 7% and 10%, respectively. Furthermore, the local buckling was generally seen less severe amongst corrugated-plate steel bridge piers. This research raises the importance of corrugated-plate sections used in bridge piers over circular shapes owing to their advantages in strength and aestheticism.

Key words: corrugated-plate, steel columns, seismic, bridge, buckling

INTRODUCTION

In the last few decades, thin-walled steel structures have been widely applied in engineering structures owing to their favorable seismic performance in regions which are exposed to severe earthquakes [1–5]. Due to their high strength, light-weight, ductility, and torsional rigidity, thin-walled steel structures are used in numerous modern applications such as urban highway bridge systems where the constructional space is limited [2–4,6–9]. In the event of heavy earthquakes, thin-walled steel tubular cantilever bridge piers are vulnerable to local and overall interaction buckling damage [1–4,9]. Consequently, a significant degradation in the load-bearing capacity and ductility takes place [1–4,10,11]. Such bridge piers are affected by radius-to-thickness ratio parameter/width-to-thickness ratio parameter, and slenderness ratio parameter [1–4,9]. Since the late 1950s, the introduction of the corrugation to the structural members have been attracted more attention in aerospace, nuclear reactors, transportation, and civil engineering structures including buildings and bridges [12,13]. Many studies have revealed the efficiency of the corrugated structures over circular and rectangular cross-sections in energy absorption, weight reduction and stiffness improvement which are high demand in the event of severe earthquakes [1–4,12,14].Moreover, the manufacture or fabrication process of the corrugated structures becomes more affordable with advanced manufacturing technology such as 3D-printing technology [12]. Therefore, corrugated thin-walled steel tubular columns are believed to have an improvement in the overall seismic performance including the load-bearing capacity and the local buckling under seismic loadings. Steel tubes with corrugated shapes have been attractive topic for several research due to the lack of relative studies in the past. However, all available recent studies focused on the performance of steel tubes with either rounded or semi triangular plates [15–18]. More importantly, the axial behavior (static condition) prevailed the literature. Thus, the seismic behavior of steel tubes with new cross-section like straight ribbed corrugation (see Fig 1c) remained a research gap that needs to be bridged. For this reason, the current study aims to highlight the potential influence of usage of innovative corrugated plate in steel bridge piers. The authors herein believe that such cross-section would advance the performance of bridge piers in seismic zones in terms of load-bearing capacity, and buckling mode. A number of steel bridge piers subjected to constant axial dead load and lateral cyclic displacement are numerically analyzed using ABAQUS 6.14/standard. The parametric study centered around the configuration of bridge piers (from circular to corrugated) and different thicknesses of thin-walled steel tubes. The finite element (FE) results suggested a greater load-bearing capacity and ductility of bridge piers having corrugated-shaped than those with circular sections. Moreover, the superior performance in results was reported as the geometry of corrugated-shaped was made deeper. The current

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