

Review Study on the Effect of Knotted and Knotless Knot based on Strength Properties of the Fishing Nets

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Abstract: Fishing nets are regarded as the most critical component in fishing gear yet a common problem still occurs where fracturing during hauling overweighted fishes to the ships. This paper review studies on the effect of knotted and knotless knot based on strength properties of the fishing nets based on the previous studies of the current knowledge and point out areas for further research. The method to gain the finding of the review will consist of two steps; (i) identifying the literature study and (ii) mapping the content of the selected study. Based on research, the Angle of Attack (AOA) of knots can decrease the Drag Coefficient (D_c) and Reynolds Number (R_m) during hydrodynamic force flow into the netting panels in a uniform velocity of the water. To summarized, the theories based on literature studies can be used to gain the findings to provide strong support for the review study.

Keywords: Knotted Knot Nettings, Knotless Knot Nettings, Nettings, Netting Properties, Netting Structure, Fishing Nets, Fishing Nets Strength, Fishing Net Impact

1. Introduction

In the fisheries industry, one of the most widely used for achieving better results on fishing is the implementation of selecting fishing gears [1]. Zou (2020) stated that fishing nets are regarded as the most critical component in fishing gear, which is characterized as a complex, flexible, and porous structure [2]. To revolutionize the fishing nets, the textile industry began to solve problems that had been occurred by improvising the fishing net's material fiber and knots. In particular, this report review aims to determine the effect of knotted and knotless knots based on the strength properties of fishing nets. The common knot used in the textile industry is the English knots and the knotless knot that was invented in 1922 by the Japanese Nippon Seimo Co.Ltd [3]

According to Tang (2018) [4], different knot types influence the solidity ratio netting, which may result in differential hydrodynamic force. Knots can account for up to 15.00-25.00 % of the total drag,

and exhibit an increasing drag coefficient (C_D) with increasing solidity [5]. Based on research, it is possible to find the strength properties of the knotted and knotless knots in the fishing nets that increase the strength of the nets and maximizing the performance during pulled at the water.

1.1 Problem Occur in Fishing Nets

The main common problem that occurs is the fracturing of the nets during hauling back to the ship. According to Chimisso (2010) [6], many of the nets are lost, resulting in undesirable residues that pollute the marine environment and harming wildlife. Currently, little is known about the mechanical properties of the knots in fishing nets. Thus, a study had been developed for finding a solution knowing the maximum of value tensile stress is needed to fracture the nettings. Based on the result that has been gain and compared with one that complies with ISO – 1806 (1973), differences are seen due to the placing of the knot during the tensile test. Yet, it is not enough to solve the problem of fracturing nettings.

1.2 Aims for the Fishing Nets

Broadhurst (2016) [7] stated that the centerline of the knots profile used to make a mesh of nettings has an effective AOA where asymmetric relative to the plane. The study can be related to the purpose of the review studies where the hydrodynamic force acts as stress resulting in accumulated drag and side force. Therefore, by executing review studies based on other research studies gain more understanding of the purpose and also to find whether knots help to minimize the stress on nettings.

2. Materials and Methods

The method used in literature review based on Sandin & Peters (2018) [8] consists of two steps: (i) identifying the literature study, by searching journals and articles related with the goal of the review studies with a set of rules for selecting the pieces of literature, and (ii) mapping the content of selected literature to be studied by extracting the information using a set of question.

2.1 Identifying Literature study

To collect the findings that related to the review of the study, usage of search engines for searching journals and articles such as Scopus, Science Direct, and Google Scholar database will be applied as a method to find a suitable literature study from 2015 until 2021. The purpose of the period is to reassessment of the literature study whether it is suitable for the study review and also adapt to changes in the condition of the period given. Using the following Keyword search; “knotted knot nettings” OR “knotless knot nettings” OR “Nettings” OR “nettings properties” OR “nettings structure” OR “fishing nets” OR “fishing nets strength” AND “Fishing net impact” helps to find several journals and articles that have the same aspect of the study review. Other relevant literature studies that can be used had to encountered screening or reviewing to ensure it has the same aims as the review study.

Based on Sandin & Peters (2018), several rules need to be followed to select a relevant and manageable set of studies among the identified pieces of literature. The rules are;

- Inclusion of any type of available study (published, whether peer-reviewed or not).
- Inclusion of studies on any category knots and nettings.
- Inclusion studies of any geographical scope.
- Exclusion of any studies that do not include quantitative results, or which have merely reproduced the quantitative results of others.
- Exclusion of studies older than 6 years (before 2015), unless the literature studies have a point that needed in this review studies.

- Exclusion of studies in languages other than English.
- Exclusion of studies of “Ocean Environments”, unless it can be related to the review studies within the scope.

If the following rules are followed, the next method can be proceeded to help better understanding what the review study will be the focus on and get the result that it desired.

2.2 Mapping Content

Identifying a literature study is not enough to extract all the information that is needed to gain the result for the review studies. Therefore, mapping the content of the review studies is highly needed. Sandin & Peters (2018) state that the content of selected studies is needed to be mapped by extracting information using some following question that helps to direct the result findings for the review studies. The following question is;

- What is the aim(s)?
- What method(s) is used?
- What product system(s) is studied?
- What knots will be studied?
- Are the knots give benefits as a function in the fishing nets?
- In the case of strength properties, is the knots help to maximize the efficiency of fishing nets?
- What is the geographical scope?
- What allocation method(s) is used?
- Is primary data is shown? If so, how the data is process?
- What is the conclusion that is taken can impact the improvement of the fishing nets based on the effect of knots?

With the question acts as a guideline, the review studies will achieve the expected result from every literature study that has been searched and connect with the objective of this review studies that been stated in chapter 1.

3. Results and Discussion

3.1 Overview of Publication

Table 1 provides the overview of the content of selected research journals in terms of selected publication, type of fiber materials that have been used to form nettings, types of knots that have been used in literary studies, and the effect of the knots.

Table 1: The content of a selected publication, in terms of fiber materials of nettings, knots used, and the effect of knots in the studies

Author and Year of Publication	Fiber materials in nettings	Knots have been used	Effect of knots in the Studies.
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Kebede & Winger, 2020	Nylon and polyethylene (PE)	Knotted and Knotless	Knotted and knotless nettings exhibited an increase in both lift (L) and drag (D) trends with increasing water velocity. Yet having different results from Kruskal-Wallis statistical test.
S.Dong et al., 2020	Polyethylene (PE)	Knotless	The increasing of Drag coefficient, C_D , and the Mass coefficient, C_M is shown with the netting solidity where wave height had a positive effect on the wave force acting on the netting panels.
Zou et al., 2020	Polyethylene (PE)	Knotless	The parallel and normal drag forces increased as the solidity ratio increase while netting was inclined to the flow direction, decreased drag forces when AOA is at 45 degrees.
G.Dong, Tang, Xu, Bi & Guo, 2019	Nylon	Knotted and Knotless	The size of the knotted and knotless knots verifies the on the AOA to gain negligible influence on the wave force.
Tang et al., 2018	Nylon	Knotted and Knotless	The drag coefficients of knotless netting decreased as Reynolds numbers based on twine diameter increased where the knotted nettings have more drag coefficient which opposite result of the knotless nettings.
Broadhurst et al., 2017	Polyethylene (PE)	Knotted	Knot orientation based on positive or negative AOA in horizontal panels produces main results either building hydrodynamic side force and changes in system geometry.
Broadhurst et al., 2016	Polyethylene (PE)	Sheet bend knot	A study in knots orientation based on different positions of AOA shows similar catches of fishes in the nettings.

Li & Chen, 2016	Nylon	Knotted	To show a simulation on the nettings using Matlab based on the motion process of the netting panel, equilibrium state based on the data in flume tank test, and the tension distribution of the whole netting panel.
Zhou et al., 2015	Nylon	Knotless	The different positions of the netting panels affect the hydrodynamics force due to the AOA of the knot.
Chimiso, 2010	Unknown	Knotted	Netting meshes show former present higher forces and lower standard deviation occur during the tensile test been done.

Table 1 shows the publication studies where the common studies on hydrodynamic forces, drag coefficient, AOA of knots, and Reynolds number (R_m) (80.00 % of the publication) have a similar foundation to the review studies where its research knots the strength properties of fishing nets. Nylon and polyethylene (PE) are the most used fiber material for nettings. The knotted and knotless knot is the main point for these review studies.

3.2 Aims and Scope of Publication

The most commonly stated aim is some version of “to investigate the nettings based on X”. This is the case in about 80.00 % of the publication. Most of the aims commonly describe what will be done in the study rather than finding the effect of knots on the fishing nets. Among the studies, several works show the effect of netting based on experimental work while the other works show the numerical simulation of nettings and studies on the knot strength by using tensile stress.

3.3 Method Used in Publication

About 10 publication used nettings that has knots for the experiment. The method that used in the research S.Dong (2020) [9], where the setup consists of wave tank simulation to form hydrodynamic forces in the knotless PE netting panel, where the mesh is measured in length (l) and bar diameter (d). This is also studied from Broadhurst (2016) [7] where several tests of AOA in the netting panel are needed to find the best minimum drag force in the nettings.

3.4 Publication Findings that Related to Review Studies

Based on the Publication, hydrodynamics force is similar to the strength properties that can be connected to the review studies. The result from Broadhurst (2016, 2017) [7], [10], G. Dong (2019) [11], S. Dong (2020) [9], Kebede &Winger (2020) [5], Tang (2018) [4], Zhou (2015) [12], and Zou (2020)[2] stated that AOA of knots can decrease the C_D and R_m during hydrodynamics force flow into the netting panels correspond to a given flow velocity where it is shown in Figure 1 and Figure 2.

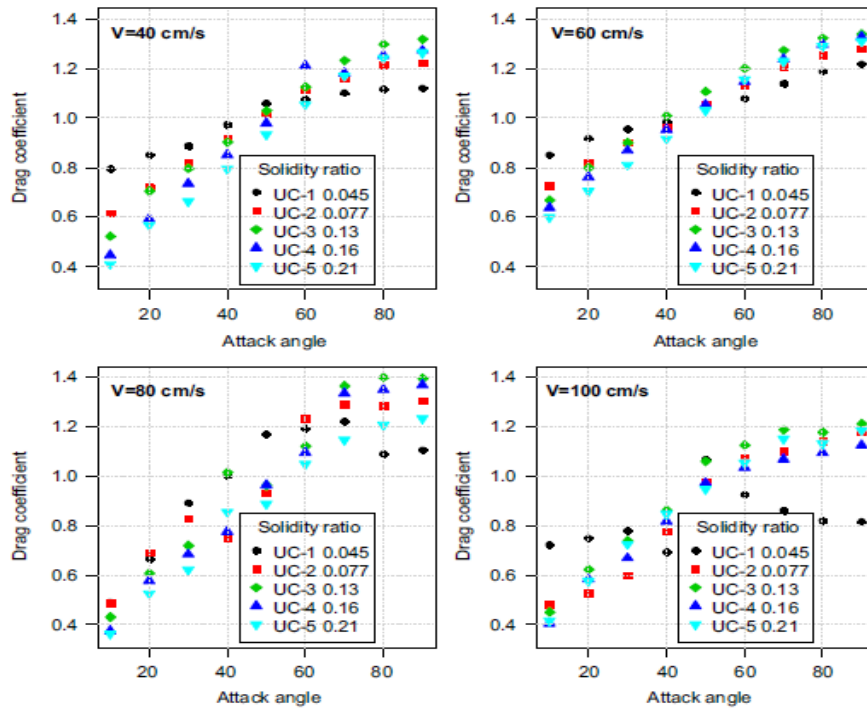


Figure 1: Comparison of drag coefficient of inclined netting with varying solidity ratio against angle. Each plot corresponds to a given flow velocity

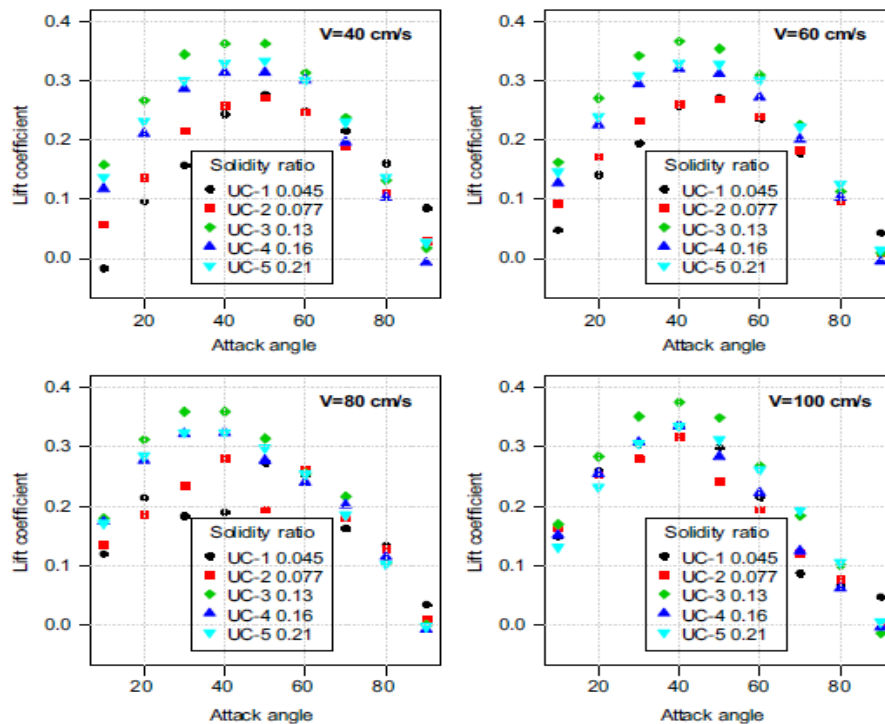


Figure 2: Comparison of lift coefficient of inclined netting with varying solidity ratio against angle. Each plot corresponds to a given flow velocity

The result from Zou (2020) [2] stated that the parallel and normal drag force will increase when the solidity ratio increase. This shows that velocity flow will affect the parallel and normal drag. Figure 3 shows that during the panel is lifted when the netting incline to the flow of direction, it shows the drag, AOA, and solidity ratio increase when the knotless PE netting is inclined. Yet after the raising panel

reaches its maximum and the AOA is at 45°, all the drag and velocity decreased while the AOA is increased.

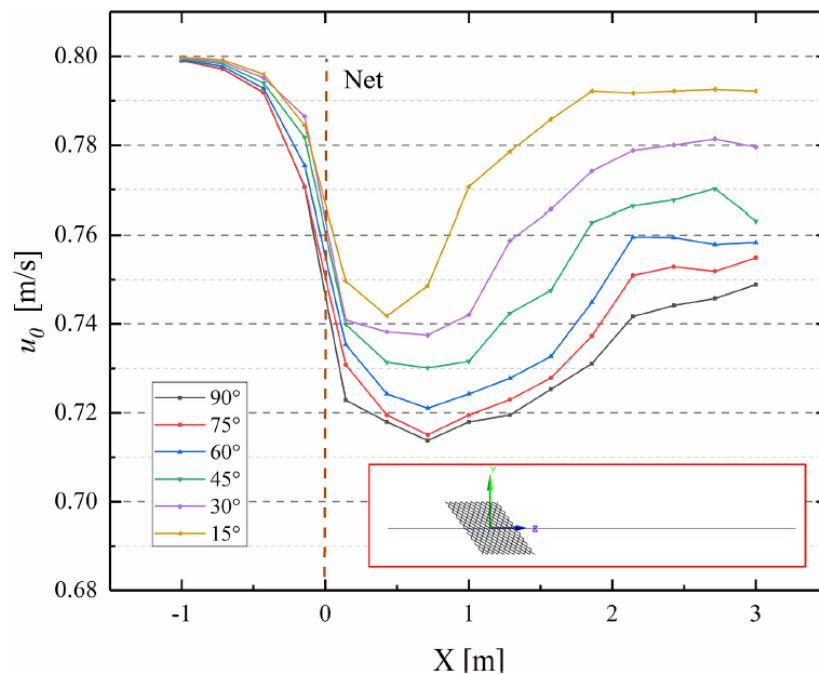


Figure 3: Flow variation along the central line through the netting at different attack angles

4. Conclusion

Base on the findings, the review studies can be concluded that one of the objectives cannot be fulfilled due to the small scale of literature studies that can be found to study the effect differences of knotted and knotless knots based on the strength properties of fishing nets. Yet, the review still can be done by evaluating the knotted and knotless knot based on the strength properties of the fishing nets using similarity. Therefore, all theories based on similar literature studies can be used to assess in the review study on the effect of knotted and knotless knots based on the strength properties of fishing nets.

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