Analysis of the usage of the android-based scantling calculation application for wooden ship construction for survey activity based on BKI vol vii 2013 rules

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Abstract. In survey activities at wooden shipyards, surveyors often find scantling calculations not comply with the regulations. Because the use of technology has not yet developed, based on traditional technology development so that the weakness occurs in the design and construction. The survey system for scantling calculation is yet manually, surveyors write actual results and carry documents in paper form which is less efficient. Designing media in the form of android application for calculating wooden ship scantling based on BKI Volume VII 2013 rules concerning ‘Rules for Small Vessel Up to 24 M’ is needed. The initial step of a design application is creating database structure that normalization BKI table become a system, then, making a mock up for display. After that, create functional as back end system that is processing database and front end that is screen display, and the last step is creating system for reporting result. This application accessed by input the actual data of wood type, mechanical properties and main dimension on each form, then the application will display the results of BKI calculations. The surveyor fills actual data of scantling in column and gives mark if the results comply and will gives a note if not complied then insert a photo to prove. The PELRA ship with length overall (LOA) of 17.65 meters used as the research object. The questionnaire is applied to know response of user about the application. The results, a total percentage is 75.6% to average total score is 37.8 which shows that the application very helpful to assist survey activities. The conclusion, the use of android application for scantling calculation of wooden ship construction is needed because more practical and can accessed anywhere compared to manual survey systems, more efficient in terms of time, and more safety for data storage of report.

1. Introduction
In survey activities at wooden shipyards, surveyors often find scantling calculations not comply with the regulations. One of the reasons during the shipbuilding process, the calculation procedure is carried out only by relying on the ability of the workers where most of the workers do not have an educational background in naval architecture so they do not follow scantling of BKI rules. The design process of the current structure far exceeds the compliance effort. But what happens to the traditional ships technology is the use of technology has not yet developed, based on traditional technology development so that the weakness occurs in the design and construction due to motorization of ship propulsion. Therefore, in order to improve ship design in the future it must be able to know the importance of realizing the best standard of ship design, because ship should be in accordance with the required standards and with the classification standards [1].

Survey system technology for scantling calculation of wooden ship construction is yet limited, surveyor did survey manually it caused the survey and reporting less practical and efficient. In a manual system surveyor writes actual scantling results, in addition, surveyors must carry documents in paper
form which is vulnerable and will have an impact on the report if the notes cannot be read. This is can affect flexibility in survey activity in shipyard.

With development of mobile network, people want to achieve more tools software implementation on mobile phones for convenience. Android mobile phone platform is open enough to meet the requirements [2]. Android is a mobile system that is based on modified version if Linux, it was originally developed by a start up of the same name, Android Inc. The main advantage of adopting Android is that offers a unified approach to application development. Developers need only develop for Android, and their applications should be able to run on numerous different devices, as long as the devices are powered using Android [3]. Android platform provides developers huge opportunity to develop applications to cater to the needs of its ever increasing user base. The Android platform includes applications, middleware and the operating system. Developers use the Android SDK, which consist of various tools and Application Programming Interfaces (APIs) to develop applications using programming language like Java. Android provides an open marketplace wherein developers can sell and distribute applications instantly [4]. With the routing Android mobile device has access to multiple applications and is available for the latest system updates, greater aesthetic enhancements to the operating system, increased device speed, increased battery life and many more [5].

To assist the surveyor’s work, design a media in the form of android-based application is needed. Design android application for calculating wooden ship scantling is based on BKI Volume VII 2013 rules concerning 'Rules for Small Vessel Up to 24 M'. The rules apply to pleasure craft of length from 6 to 24 m and provided that the pleasure craft classed and approved in accordance therewith are at all times employed exclusively under the conditions for which they have been designed, constructed and approved and that they are in the sense of good seamanship correctly handled and equipped and operated at a speed adopted to the respective seaway conditions. These rules apply to the scantling determination of the structure of sailing craft, motorsailers and motor yachts of normal monohull form, traditionally carvel or clinker built on transverse frames [6].

Only proven boatbuilding wood shall be used for all timber components exposed to water and weather, i.e. timber with good resistance to water and weather, fungal attack and insect infestation, as well as with good mechanical properties that are also suitable for the particular application. Furthermore, it shall have a low swelling and shrinkage properties. The timber divided into durability group from I to V, whereby group I very good, group II good, group III average, group IV moderate, and group V poor [7].

The timber used in boatbuilding shall, if exposed to the weather or used for the primary structural components of a boat, belong to at least durability group III. The aim of this research is to analyze usage of the android-based scantling calculation application for wooden ship construction for survey activity based on BKI. Determination of the component scantlings of structural members shall be carried out in accordance with excerpt tables respecting the scantling numerals in equations (1) or (2):

\[
\frac{B}{3} + H
\]

\[
L \left(\frac{B}{3} + H\right)
\]

The scantling length is determined as follows:

\[
L = \frac{L_H + L_{WL}}{2}
\]

Structural members of hulls with larger dimensions or unusual proportions shall have the scantlings determined by individual calculations. The length \(L_h\) in [m] of the hull is the horizontal distance between the foremost and the aftermost part of the craft, the length includes structural and integral parts of the craft. The waterline length in [m] is the distance between the foremost and the aftermost intersections of the hull with the flotation plane [6].

Design application is closely related by database; all data must create to be a database and become one system. A database is an ordered collection data, which is normally stored in one or more associated files. The data are structured as tables, where cross references among tables are possible. In this research all database is processing in MySQL. My SQL is example relational database system. Such a system includes the programs for managing relational databases. Among the tasks of a relational database
system are not only the secure storage of data, but also such jobs as the processing of commands for querying, analyzing, and sorting existing data and for storing new data [8]. The advantage using MySQL is open source support, low overhead, available large table size for database and all feature have good stability [9].

2. Method

The initial step of a design application is creating database structure that normalization table become a system, the data of database is containing scantling calculation from BKI 2013. Then, making a mock up that visualizes the appearance of the application. After that, create functional as back end system that is processing database. The functional is get request data from database and posting by sending request data to database. The next step is creating front end system, about button, display content from back end system and screen display for user, front end must create synchronic with back end system. The last step is creating system for reporting the result. The figure 1 is all of database that create in MySQL.

![Database in MySQL.

Figure 1. Database in MSQL.](image)

Object of this research is the PELRA ship with length overall (LOA) of 17.65 meters, length water line (LWL) 13.13 meters, breadth (B) 4 meters, height (H) 1.84 meters, draft (T) 1.02 meters and speed (Vs) 7 knot. For validation application, the questionnaire method with rating scale answer is applied to know the user response about the application. The application tested by 5 respondents, that is wooden shipyard workers. Each of respondent fills a questionnaire that containing 10 questions. List question of questionnaire are:

1. Is this android application enough to help surveyors works?
2. Is the use of this application system more practical when compared to the manual system in the shipyard?
3. Are the features in the Android application sufficient to current needs?
4. Is this application needed for survey activities?
5. Does this android application provide significant benefits?
6. Is the time using this android application efficient enough?
7. What is the level of completeness of the features in this application?
8. Is the level of safety in data storage better than the manual system?
9. Is this the application comfortable to use?
10. Is the appearance of this application interesting enough?

Answer from each question have 5 rating scale, that is:

1 (Strongly Disagree)
2 (Disagree)
3 (Neither Agree nor Disagree)
4 (Agree)
5 (Strongly Agree)
Each respondent can provide a total rating of 10 to 50 with the following information:
1. 1-10 : Not helpful at all
2. 11-20 : Not very helpful
3. 21-30 : Moderately helpful
4. 31-40 : Very helpful
5. 41-50 : Extremely helpful

User of this application is surveyor. First step when user finished register then input all the actual data of ship. The actual data are result of material testing that been tested in laboratory, main dimension, and scantling construction and connection data of ship. If user input actual data, the application displays result mechanical properties of material, scantling, and connection from BKI 2013 automatically. After calculating, all of data will recapitulated in history and then history will have recapitulated to the database automatically. To describe how the application can run in figure 2 occur application flow scheme.

![Application Flow Scheme](image)

Figure 2. Application Flow Scheme.

3. Discussion and Result
First step, user must register and input personal data for make an account. There is user name, password, user address, phone number and e-mail address. The application will display the main menu see figure
4, then user choose survey menu. Second, user choose material menu and choose type of wood then the application displays standard mechanical properties from BKI that is durability group, density, and testing standard as a tension test, compression test, bending test see figure 6, and user can input the actual data mechanical properties of material. Third, the application automatically changed into scantling menu. User must input the actual main dimension of ship see figure 7, then scantling result from BKI will displayed and user can input all actual scantling data of construction structure member as figure 8 until figure 12. Forth, the connection form displayed automatically then user input the actual connection data see figure 13 and figure 14. The surveyor can give a check mark in check box, attach a picture, information or note in note column. The end of each menu user must push the save button to save all data. The data can have reviewed later in history menu. figure 3 until figure 15 below display how the application work:

**Figure 3.** The user must input personal data in register menu. Then user have an account to access the application.

**Figure 4.** The main menu there are survey, calculate, and history. The history save all personal and calculate data by the ship project.

**Figure 5.** In survey menu, user must choose the material menu first to input the mechanical properties of wood.

**Figure 6.** In material menu, user only input the name of ship and wood type. Then mechanical properties of wood will displayed.
Figure 7. After input mechanical properties to calculate scantling the member of construction, user must input actual data of the main dimension of ship.

Figure 8. The result of frame space from BKI and actual data. The frame space complying the standard of BKI.

Figure 9. Result of keel calculation from BKI 2013 standard and the actual data from ship.

Figure 10. Result from application for stem and sternpost in actual data and BKI 2013 standard.
Figure 11. The result from superstructure side wall that is complying the BKI 2013 standard.

Figure 12. Superstructure deck calculation that the last form from scantling menu, the user must choose save button to saving all calculation data.

Figure 13. The connection menu form, the bolting of keel, deadwood, transom beam, stem and sternpost.

Figure 14. The diameter size of screw for shell with frames and deck planks to deck and shell beams.
In table 1, all of scantling calculation from BKI 2013 and actual data displayed. Based on the calculation, a few structural member of construction not comply the BKI 2013 volume VII standard. In scantling calculation, beam shelves and thickness of collision bulkhead not comply the standard but in connection, all actual data is complying BKI standard. All result is tabulated in table 1 and table 2 down below:

| Structural Member     | BKI 2013 | Actual Data | Note   |
|-----------------------|----------|-------------|--------|
| Frame Space           | 339      | 400         | Comply |
| Keel                  | Height x Width 137 x 209 | Height x Width 225 x 250 | Comply |
| Stem and Sternpost    | Height x Width 137 x 209 | Height x Width 225 x 250 | Comply |
| Beam Shelves          | Height x Width 92 x 71 | Height x Width 60 x 140 | Not comply |
| Shell                 | Thickness x Width 127 x 145 | Thickness x Width 140 x 160 | Comply |
| Deck                  | Thickness x Width 32 x 25 | Thickness x Width 40 x 30 | Comply |
| Collision Bulkhead    | Thickness 50 | Thickness 40 | Not Comply |
| Other Bulkhead        | Thickness 30 | Thickness 50 | Comply |
| Wrang                 | Height x Width 141 x 71 | Height x Width 150 x 80 | Comply |
| Frame                 | Height x Width 36 x 28 | Height x Width 140 x 60 | Comply |
| Structural Member | BKI 2013 (mm) | Actual Data (mm) | Note |
|-------------------|---------------|------------------|------|
| Frame Space       | 339           | 400              | Comply |
| Deck Beam         | Height x Width 46 x 36 | Height x Width 140 x 50 | Comply |
| Superstructure side wall | Thickness 26   | Thickness 30     | Comply |
| Deck              | Thickness 20   | Thickness 30     | Comply |

Table 2. Result of Connection (Bolting and Screw).

| Type of Connection | BKI 2013 (diameter in mm) | Actual Data (diameter in mm) | Note |
|--------------------|-----------------------------|------------------------------|------|
| Bolt in keel, stem/sternpost, and transom beam | 20 | 20 | Comply |
| Bolt in horizontal knee | 10 | 10 | Comply |
| Connecting floors with keel and shell and frame; bolt in arms | 9 | 9 | Comply |
| 0.8 LWL (in throat) | 12 | 12 | Comply |
| In the end of yacht | 12 | 12 | Comply |
| Screws in shell and deck; shell with frames screws | 7.5 | 7.5 | Comply |
| Screws in shell and deck; shell with frames screws; deck planks to deck and shell beams screws | 7 | 7 | Comply |
| Screwing hanging knees and shelves to frames and deck beams | 0 | 0 | Comply |
For the validation questionnaire have filled by 5 respondents and the result of questionnaire tabulated in table 3 down below:

Table 3. Score of Questionnaire.

| Respondents | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Total Score | Percentage (%) |
|-------------|----|----|----|----|----|----|----|----|----|----|----------|----------------|
| 1           | 5  | 4  | 3  | 4  | 5  | 4  | 4  | 3  | 3  | 3  | 39       | 88              |
| 2           | 4  | 5  | 4  | 5  | 3  | 4  | 3  | 4  | 3  | 4  | 39       | 80              |
| 3           | 3  | 3  | 3  | 4  | 4  | 3  | 4  | 3  | 3  | 4  | 34       | 76              |
| 4           | 4  | 5  | 3  | 5  | 4  | 4  | 4  | 4  | 3  | 4  | 40       | 70              |
| 5           | 5  | 4  | 4  | 5  | 3  | 3  | 3  | 3  | 3  | 4  | 37       | 83              |
| Sum         | 21 | 21 | 17 | 23 | 18 | 20 | 17 | 18 | 17 | 17 | 189      |                 |
| Total       |    |    |    |    |    |    |    |    |    |    | 37.8     | 75.6            |

4. Conclusion and Recommendation
The highest score is 23 from question number 4 that is the application need for survey activities. The results of questionnaire analysis, a total percentage is 75.6% to average total score is 37.8 which shows that the android application very helpful to assist survey activities. The conclusion, the use of android application for scantling calculation of wooden ship construction is needed because the application more practical and can accessed anywhere compared to manual survey systems, more efficient in terms of time, and more safety for data storage of report. It is recommended to maintain the accuracy of calculation and updated system the application.

Acknowledgement
I would like to express my special thanks of gratitude to my supervisor for his expert advice and I would also like to extend my gratitude to all people for their continuous support and encouragement for my pursuit.

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