

Application for Ship Construction for Wooden Vessel by Using Matlab

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ABSTRACT

There is a rule issued by authorized classification to ensure that a ship building is in safety condition during cruising or fishing. In fact, traditional shipyard builds wooden vessels in unique way, and it often neglects the government rules due to many reasons. The main reason is many difficulties in technical calculation of the ship building process and it is confusing when applied to the vessels. Labor education background supposed to effects the concept. They rely on their descent skills and experiences. However, it is not guarantee to produce seaworthiness of wooden vessels. It needs rule issued by government to convince the ship product, and may not in jeopardy condition. This research aim to built an application by using Matlab to calculate the construction rule and make it simple, but it can be used in the traditional shipyard and satisfy the Indonesian Bureau of Classification. Data obtained are presented in Graphycal User Interface and built in *syntaks*, followed the formula given by the class. Result shown that the application can be use to facilitate the construction calculation.

Keywords : traditional shipyard, wooden vessel, Matlab, Graphycal User Interface

INTRODUCTION

As of now, demand for wooden vessel showing its existency amid any difficulties to obtain the wood as a primary material. Although others composite materials, as fiber, have been found and developed to substitute wood for whole ship materials, some groups of small industries including fisherman, prefer to retain wood as a ship materials. Many reasons for the cause of this phenomenon, for instance their minimum educational backgrounds that effect their skills in applying new invention and innovation. In addition, minimum approach from researcher and government to introduce their research, make their knowledge remain stabil. Meanwhile, some tribe still linked with their local wisdom which enact some rules and descent knowledge from their ancestor in building a ship from wood.

Generally, in Indonesia, especially in Bagansiapi-api, wooden vessel is produced by traditional shipyard (Rengi &Hutauruk, 2015). Boats produced traditionally have been known over worldwide mainly for its strength, mechanical properties and cost. Foreign country as a customer of Bagansiapai-api shipyard in ship building order as Thailand, Philipines, Brazil ect. However, recently the order for new building shows sharply decline. The main reason is the rare of wood materials. As a result, some traditional shipyards at long last close down their business.

Though wooden ship produced from Bagansiapi-api traditional shipyard has gotten international recognition, its building process neglected rule issued by class, hereinafter we call BKI, who has an authorize in determining seaworthiness of ship. Mostly the ship that they ever build depend on their descent skills and rely on experience and instinct. The cause is the difficulties of calculation including to understand of item given by the rule (Hutauruk, 2013).

To overcome the problem, the solution is given by this research by making an application by using Matlab Laboratory to form Graphical User Interface thus the traditional shipyard can understand dan familiar with all the equation in BKI (BKI, 2006).

MATERIALS AND METHODS

The first step to build a GUI in Matlab is trasfering data requirements from BKI Rule to design desire graphycal user interface (Matlab, 2010) (Figure 1). Design user interface involves any component that help user to operate calculation, i.e. pushbutton, radio button, edit text, listbox, axes, ect.

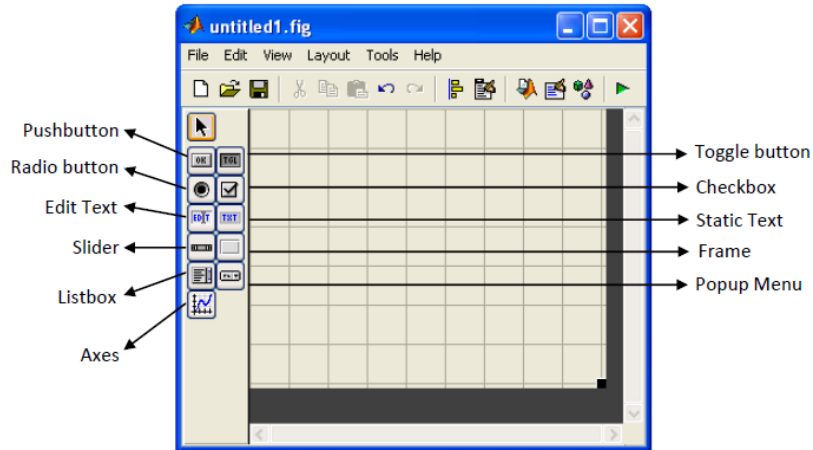


Figure 1. Components of GUI

Each of components have different function. As a result, to succeed in running program, each of component must be followed by their syntaks and make sure the formula which is tranferred from BKI is correct. The next step is data validation. After application program has been finished, the result must be tested whether conform with manual calculation. If is satisfy, the program is success and can be used. Following is the methods used to solve the research (Figure 2).

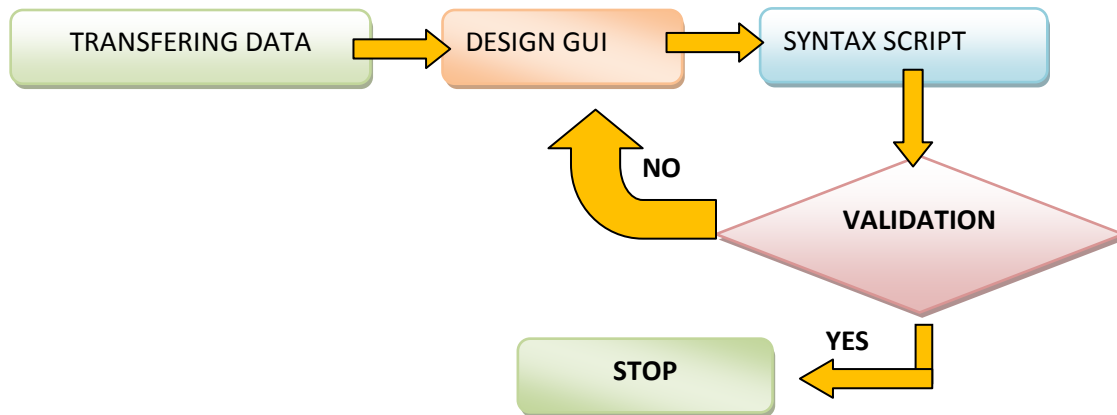


Figure 2. Flow chart of research

Some related equations using to make a GUI as a constraint in executing the input for instance

- Maximum length of floor

$$0,4.B'$$

B'= maximum length at the point (m)

- Wide of outer planking

$$15 + t / 2$$

t= thickness of outer planking (cm)

- Thickness of water and oil tank plate not less than:

$$t = 4.a\sqrt{h.k} + 0,5 \text{ [mm]}$$

a = space between stringer (m)

h =space from bottom plate side to maximum height of over flow h min = 2 m

k = material factor (k=1,0 for normal steel ship)

- Section modulus for tank stringer not less than:

$$W = c.h.a.\ell^2.k$$

h min = 2 m.

c = 3,6 if the stringer fixed support

c = 5,4 if the stringer free support

l =unsupported span of stringer (m)

RESULTS AND DISCUSSION

Ship structure comprise of many sections as hull, stringer, frame, bulkhead, keelson, deck etc. These section support the ship to posses safety strenght in facing any internal and external force during operation in the ocean (Hutauruk, 2012; Hutauruk & Rengi; 2013; 2014). To ensure all the parts of the ship in good condition, BKI rule provides a calculation standart for reaching sufficient strenght in each structure. Later on, we simplify the formula by using Matlab in accordance the user desires. Figure 3 is opening display of application. We obtains that there are two parts of the calculation of ship structure from wood, namely local and coastal cruise. Both of calculations involve series different formula. To make sure the correct choice of calculation then it is separated.



Figure 3. Opening display of Program

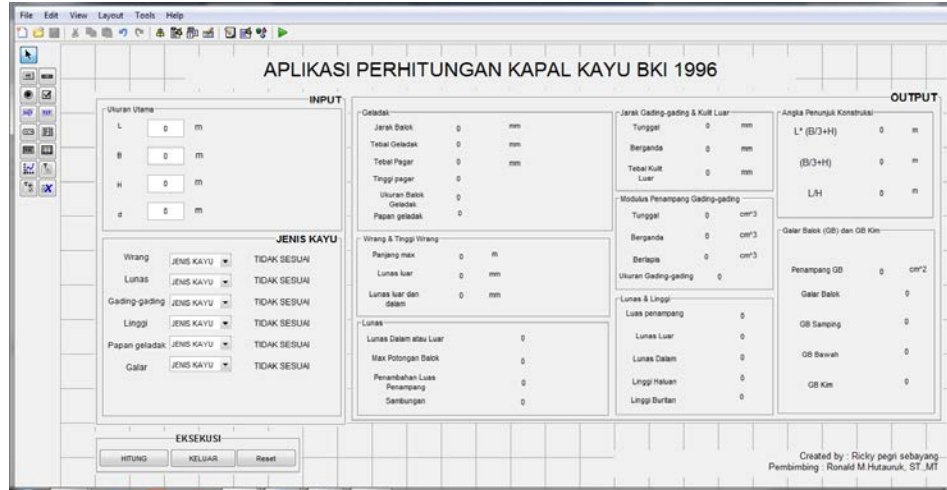


Figure 4. GUI of Application

Figure 4 shows the contain of application. There are 3 main parts of GUI i.e. input, output and exsecution. Input covers all the informations to the calculation. It requires principal dimensions of the ship and type of woods used to the ship. Meanwhile, output contains of the results of calculation, namely frame, floor, frame spacing, keelson, section modulus, etc. The output depend on the formula in BKI. The formula is writtern in syntax of Matlab and must be satisfy all the diraction of Matlab to use the syntax. Figure 5 shows the application when it runs. If the syntax is wrong, then there is information in command window of Matlab that emerge and tell us which part of syntax is wrong. Figure 6 shows that the application is testeb by making an input for initial principal dimension in research location. When the GUI is executed, the output instantly appear. We can sea the result in accordance with manual calculation.

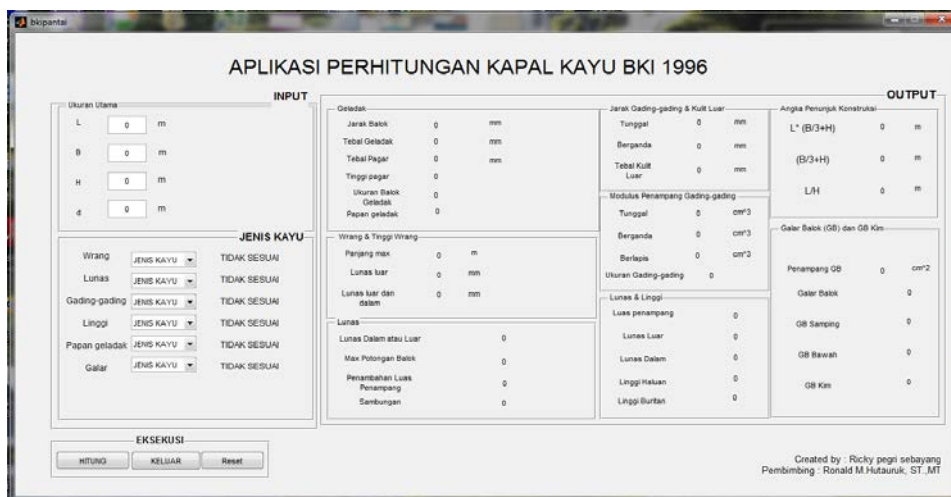


Figure 5. GUI of Application

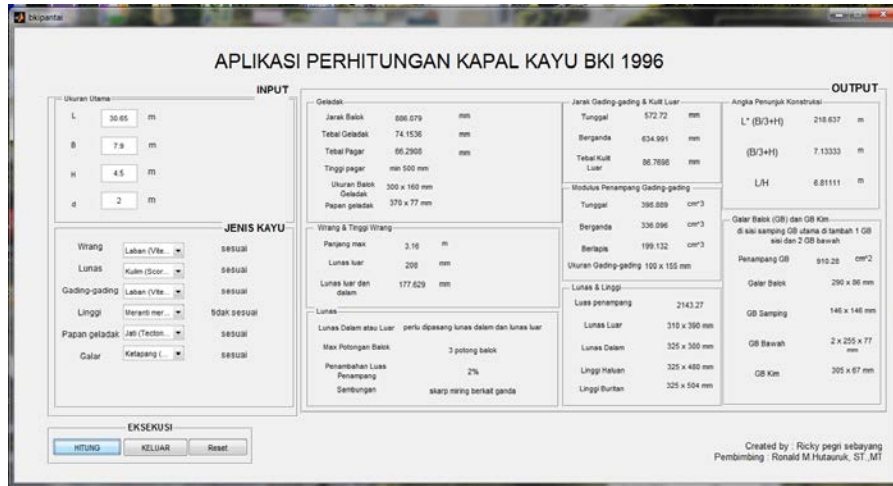
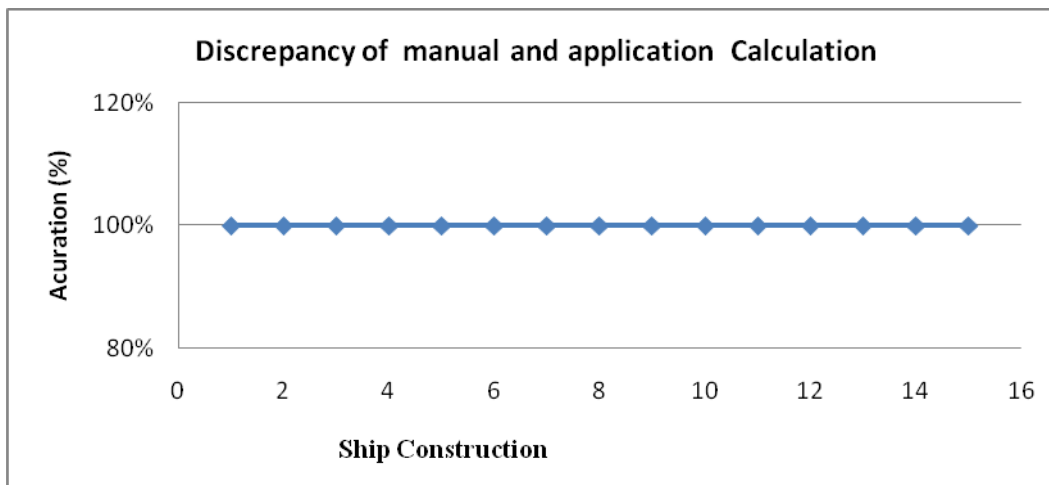


Figure 6. Execution of Application



Tabel 1. Discrepancy of manual and application calculation.

Table 1 shows the discrepancy between manual and application calculation of the ship. X axis is part of the construction, and Y axis is the acuration of calculation. There is discrepancy of both calculations. It means that the output of Matlab 100% can be used to calculation hull construction of wooden vessel in any dimensions. The script of some syntax is given bellow

```
% --- Executes on button press in HITUNG.
function HITUNG_Callback(hObject, eventdata, handles)
L=str2num(get(handles.edit7, 'string'));
B=str2num(get(handles.edit8, 'string'));
H=str2num(get(handles.edit9, 'string'));
d=str2num(get(handles.edit10, 'string'));
b=(B/3+H);
c=(L/H);
a=L.*b;
Wrang=0.4.*B
set(handles.text18, 'string', Wrang);
LPP=(9.276.*a + 115.2);
set(handles.text21, 'string', LPP);
```

```

set(handles.edit11,'string',a);
set(handles.edit12,'string',b);
set(handles.edit13,'string',c);
if a>55 & a<=150
    set(handles.text27,'string','pada sisi samping GB di tambah GB bawah
atau GB sisi')
else
    set(handles.text27,'string','di sisi samping GB utama di tambah 1 GB
sisi dan 2 GB bawah')
end
if a<140
    set(handles.text15,'string','tidak perlu dipasang lunas dalam')
else
    set(handles.text15,'string','perlu dipasang lunas dalam dan lunas
luar')
end

```

Total Section at Inner Keel and Outer Keel

```

if L<=14
    set(handles.text16,'string','1 potong balok')
elseif L>14 & L<=25
    set(handles.text16,'string','2 potong balok')
elseif L>25& L<=35
    set(handles.text16,'string','3 potong balok')
elseif L>35
    set(handles.text16,'string','4 potong balok')
end

```

Section Area

```

if c<=8.2
    set(handles.text17,'string','2%')
elseif c>8.2 & c<=8.4
    set(handles.text17,'string','4%')
elseif c>8.4 & c<=8.6
    set(handles.text17,'string','7%')
elseif c>8.6 & c<=8.8
    set(handles.text17,'string','11%')
elseif c>8.8 & c==9
    set(handles.text17,'string','16%')
end

```

Joint Type

```

if L<=15
    set(handles.text19,'string','skarp berganda')
else
    set(handles.text19,'string','skarp miring berkait ganda')
end

```

Frame

```

if b==2.4
    set(handles.text49,'string','24.5')
    set(handles.text48,'string','20.5')
    set(handles.text47,'string','12.25')
elseif b==2.6
    set(handles.text49,'string','29')
    set(handles.text48,'string','24')

```


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```
        set(handles.text47, 'string', '14.5')
elseif b==2.8
    set(handles.text49, 'string', '35')
    set(handles.text48, 'string', '29')
    set(handles.text47, 'string', '17.5')
elseif b==3.2
    set(handles.text49, 'string', '49')
    set(handles.text48, 'string', '41')
    set(handles.text47, 'string', '24.5')
elseif b==3.6
    set(handles.text49, 'string', '68')
    set(handles.text48, 'string', '57')
    set(handles.text47, 'string', '34')
elseif b==4.0
    set(handles.text49, 'string', '90')
    set(handles.text48, 'string', '75')
    set(handles.text47, 'string', '45')
elseif b==4.4
    set(handles.text49, 'string', '117')
    set(handles.text48, 'string', '97')
    set(handles.text47, 'string', '58.5')
elseif b==4.8
    set(handles.text49, 'string', '146')
    set(handles.text48, 'string', '122')
    set(handles.text47, 'string', '73')
else
    mtunggal=(2.523*b.^2.577)
    mberganda=(2.056*b.^2.594)
    mberlapis=(1.262*b.^2.576)
    set(handles.text49, 'string', mtunggal)
    set(handles.text48, 'string', mberganda)
    set(handles.text47, 'string', mberlapis)
end
```

Floor Calculation

```
if Wrang==2.4
    set(handles.text23, 'string', '170 mm')
    set(handles.text22, 'string', '140 mm')
elseif Wrang==2.6
    set(handles.text23, 'string', '180 mm')
    set(handles.text22, 'string', '150 mm')
elseif Wrang==2.8
    set(handles.text23, 'string', '190 mm')
    set(handles.text22, 'string', '160 mm')
else
    lunasluar=(50*Wrang + 50)
    luardalam=(48.62*Wrang + 23.99)
    set(handles.text23, 'string', lunasluar)
    set(handles.text22, 'string', luardalam)
end
```

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```
if a>=110 & a<120
    set(handles.text39, 'string', '410 x 84 mm', '385 x 90 mm')
    set(handles.text38, 'string', '132 x 132 mm', '-')
    set(handles.text37, 'string', '-', '240 x 73 mm')
    set(handles.text36, 'string', '280 x 62 mm')
elseif a>=120 & a<130
```

```

set(handles.text39,'string','430 x 88 mm','395 x 93 mm')
set(handles.text38,'string','136 x 136 mm','-')
set(handles.text37,'string','-','245 x 76 mm')
set(handles.text36,'string','285 x 63 mm')
elseif a>=130 & a<140
set(handles.text39,'string','490 x 91 mm','410 x 97 mm')
set(handles.text38,'string','140 x 140 mm','-')
set(handles.text37,'string','-','250 x 79 mm')
set(handles.text36,'string','285 x 64 mm')
elseif a>=140 & a<160
set(handles.text39,'string','450 x 93 mm','425 x 100 mm')
set(handles.text38,'string','145 x 145 mm','-')
set(handles.text37,'string','-','255 x 82 mm')
set(handles.text36,'string','290 x 65 mm')
else
set(handles.text39,'string','tidak sesuai')
set(handles.text38,'string','tidak sesuai')
set(handles.text37,'string','tidak sesuai')
set(handles.text36,'string','tidak sesuai')
end
if a==110
set(handles.text40,'string','520')
elseif a==120
set(handles.text40,'string','556')
elseif a==130
set(handles.text40,'string','592')
elseif a==140
set(handles.text40,'string','630')
elseif a==160
set(handles.text40,'string','710')
elseif a==180
set(handles.text40,'string','785')
else pgalarbalok=(10.98*a.^0.820)
set(handles.text40,'string',pgalarbalok')
end

```

Deck Beam

```

if a ==20
set(handles.text34,'string','450')
set(handles.text31,'string','36')
set(handles.text30,'string','23')
elseif a==25
set(handles.text34,'string','470')
set(handles.text31,'string','39')
set(handles.text30,'string','25')
elseif a==30
set(handles.text34,'string','490')
set(handles.text31,'string','41')
set(handles.text30,'string','27')
elseif a==35
set(handles.text34,'string','515')
set(handles.text31,'string','43')
set(handles.text30,'string','30')
elseif a==40
set(handles.text34,'string','530')
set(handles.text31,'string','45')
set(handles.text30,'string','32')

```



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```
else jarakbalok=(181.8*a.^0.294)
    tebalgeladak=(14.81*a.^0.299)
    tebalpagar=(6.062*a.^0.444)
    set(handles.text34,'string',jarakbalok);
    set(handles.text31,'string',tebalgeladak);
    set(handles.text30,'string',tebalpagar);
end
```

Keel and Stem

```
if a<=20 & a<25
    set(handles.text68,'string','125 x 140 mm')
    set(handles.text69,'string','130 x 115 mm')
    set(handles.text70,'string','125 x 180 mm')
elseif a>=25 & a<30
    set(handles.text68,'string','130 x 160 mm')
    set(handles.text69,'string','135 x 125 mm')
    set(handles.text70,'string','135 x 195 mm')
elseif a>=30 & a<35
    set(handles.text68,'string','140 x 170 mm')
    set(handles.text69,'string','140 x 140 mm')
    set(handles.text70,'string','145 x 210 mm')
elseif a>=240 & a<260
    set(handles.text68,'string','340 x 415 mm')
    set(handles.text69,'string','360 x 330 mm')
    set(handles.text70,'string','355 x 530 mm')
end
```

Single and Double Frame Space

```
if a==35
    set(handles.text53,'string','315')
    set(handles.text55,'string','350')
    set(handles.text54,'string','39')
elseif a==40
    set(handles.text53,'string','330')
    set(handles.text55,'string','365')
    set(handles.text54,'string','41')
else gtunggal=(102.7*a.^0.319)
    gberganda=(115.1*a.^0.317)
    kulitluar=(8.064*a.^0.441)
    set(handles.text53,'string',gtunggal);
    set(handles.text55,'string',gberganda);
    set(handles.text54,'string',kulitluar);
end
```

Syntax of Types of Wood

```
p=handles.p;
if p==1
    set(handles.text79,'string','pilih jenis kayu');
elseif p==2
    set(handles.text79,'string','sesuai');
elseif p==3
    set(handles.text79,'string','sesuai');
elseif p==4
    set(handles.text79,'string','tidak sesuai');
elseif p==5
    set(handles.text79,'string','sesuai');
```

```
elseif p==6
    set(handles.text79,'string','sesuai');
elseif p==15
    set(handles.text79,'string','tidak sesuai');
end
q=handles.q;
if q==1
    set(handles.text86,'string','pilih jenis kayu');
elseif q==2
    set(handles.text86,'string','sesuai');
elseif q==3
    set(handles.text86,'string','sesuai');
elseif q==4
    set(handles.text86,'string','tidak sesuai');
elseif q==5
    set(handles.text86,'string','sesuai');
end
r=handles.r;
if r==1
    set(handles.text87,'string','pilih jenis kayu');
elseif r==2
    set(handles.text87,'string','sesuai');
elseif r==3
    set(handles.text87,'string','sesuai');
elseif r==4
    set(handles.text87,'string','tidak sesuai');
elseif r==5
    set(handles.text87,'string','sesuai');
end
s=handles.s;
if s==1
    set(handles.text88,'string','pilih jenis kayu');
elseif s==2
    set(handles.text88,'string','sesuai');
elseif s==3
    set(handles.text88,'string','sesuai');
elseif s==4
    set(handles.text88,'string','tidak sesuai');
elseif s==5
    set(handles.text88,'string','sesuai');
elseif t==15
    set(handles.text89,'string','sesuai');
end
u=handles.u;
if u==1
    set(handles.text90,'string','pilih jenis kayu');
elseif u==2
    set(handles.text90,'string','tidak sesuai');
elseif u==3
    set(handles.text90,'string','sesuai');
elseif u==4
    set(handles.text90,'string','sesuai');
elseif u==5
    set(handles.text90,'string','sesuai');
elseif u==6
    set(handles.text90,'string','sesuai');
elseif u==7
```

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```
        set(handles.text90, 'string', 'sesuai');  
elseif u==8  
        set(handles.text90, 'string', 'sesuai');  
end
```

CONSLUSION AND RECOMMENDATION

BKI formula can be written to form GUI to simplify calculation of ship construction. Matlab as powerfull mathematic software provide any function to transfer BKI formula to be a syntax that can be executed to produce concise calculation by forming an application. Can be concluded that the output of this application can be used to calculation hull construction of wooden vessel in any dimensions and simplify calculation process of ship construction.

REFERENCES

- BKI (2006). Konstruksi Kapal Kayu. Jakarta: BKI.
- Hutauruk, R. (2010). Design of Passenger Logistic Carrier in Province of Moluccas by multifunction concept. SNPSX. Surabaya: ITS Surabaya.
- Hutauruk, R. M. (2012). Effect Of Turbulence Models In Analysing Of Viscous Resistance By Using Computational Fluids Dynamics. SENTA 2012 (hal. 83-90). Surabaya: ITS Surabaya.
- Hutauruk, R. M. (2013). Perhitungan Stabilitas Kapal Perikanan Melalui Pendekatan Ukuran Utama Dan Koefisien Bentuk Kapal. Jurnal Perikanan dan Kelautan , 48-61.
- Hutauruk, R. M., & Rengi, P. (2014). Contribution of Fishing Vessel Hullform on Ship Safety. ISFM (hal. 80-87). Pekanbaru: Unri Press.
- Hutauruk, R. M., & Rengi, P. (2013). Wave Surface Simulation On Optimized Fishing Vessel Hullform. ISFM 2013 (hal. 119-131). Pekanbaru: Unri Press.
- Matlab(2010). Help and Guide of Matlab.
- Rengi & Hutauruk, R. 2015. Aplikasi Perhitungan Stabilitas berbasis Matrix Laboratory. SNITS. Politeknik Negeri Bengkalis. Proceeding