

**D&L#1393 45.5'x20'x6'-5" NCDOT Assist TowBoat**

Length-L=	45.50 ft
Beam-B=	20.00 ft
Depth-D=	6.50 ft
Draft for scantlings-(d)=	4.00 ft
Δ Disp. @ Scantling Draft =	80.00 lt
Beam <sub>wl</sub> Δ(waterline beam @ max draft)=	20 ft
Disp. @ Max Draft ∇ (Volume) =	2800 ft <sup>3</sup>
Max. spacing-Hull:	24.00 in
Max. spacing-Sideshell:	24.00 in
Max. -Main Deck:	24.00 in
C <sub>b</sub> =	0.769

**Author:** M. Jacob Connally  
**date:** 1/2/2019  
**alt:** 0



**3.2.1.3.1 Longitudinal Hull Girder Strength**

$$SM = C_1 C_2 L^2 B (C_b + 0.7) \text{ ft-in}^2$$

C <sub>1</sub> :	15.211
C <sub>2</sub> :	0.000144
C <sub>b</sub> :	0.75
(3-2-1/7.5) Q <sub>factor</sub> :	1
SM <sub>min.</sub> :	131.50 ft-in <sup>2</sup>
SM <sub>act.</sub> :	548.71 ft-in <sup>2</sup>
MOI <sub>min.</sub> :	179.68 ft <sup>2</sup> -in <sup>2</sup>
MOI <sub>act.</sub> :	2194.81 ft <sup>2</sup> -in <sup>2</sup>

D&L#1393 45.5'x20'x6'-5" NCDOT Assist TowBoat

### HULL GIRDER SECTION MODULUS CALCULATION

Typical midship section:

Note: Y is to be taken from the Baseline

Item	Scantlings	Area in <sup>2</sup>	Y (ft)	AY	AY <sup>2</sup>	h (ft)	(Ah <sup>2</sup> )/12	I-part (in <sup>4</sup> )
Bottomshell	3/8" pl	90	0	0.00	0.00	0	0.00	1.05
Sidesehll	5/16" pl	58	3.25	188.50	612.63	6.5	204.21	24716
Deck Plate	1/4" pl	60	6.5	390.00	2535.00	0	0.00	0.3125
Keel	3/4x9" F.B.	8	0.25	2.00	0.50	0.75	0.38	45
Long. Hull Girders	3/8" pl web w/ 1/2x6" f.b. cap	40	0.8333	33.33	27.78	1.33	5.90	1500
Long. Deck Girders	6x4x3/8" L	7.22	6.125	44.22	270.86	0.5	0.15	27
				0.00	0.00		0.00	
				0.00	0.00		0.00	
				0.00	0.00		0.00	
				0.00	0.00		0.00	
				0.00	0.00		0.00	
<b>TOTALS:</b>		263.22		658.05	3446.76		210.63	182.57

in<sup>2</sup>xft<sup>2</sup>

Deck Height ABL =  ft.

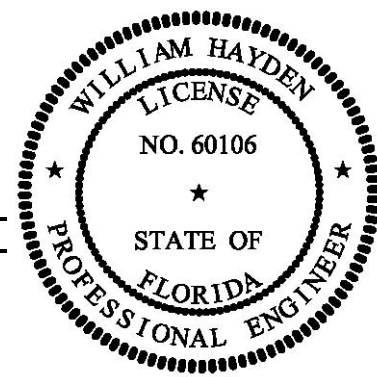
Neutral Axis =  ft.

Depth - Neutral Axis =  ft.

Inertia =  in<sup>2</sup>ft<sup>2</sup>

Section Modulus (Bottom) =  in<sup>2</sup>ft

Section Modulus (Top) =  in<sup>2</sup>ft



3.2.1.3.1 Bottom Shell Plating

3.3.1

$$t = \frac{s\sqrt{h}}{460} + 0.10 \text{ in}$$

3.3.1 Bottomshell  $t_{req.}$ : 0.211 in.

3.3.2 Bottomshell  $t_{req.}$ : 0.214 in.

Bottomshell  $t_{act.}$ : 0.375 in.

3.2.1.5.1 Sideshell Plating

3.5.1

$$t = \frac{s\sqrt{h}}{485} + 0.10 \text{ in}$$

Sideshell  $t_{req.}$ : 0.2262 in.

Sideshell  $t_{act.}$ : 0.3125 in.

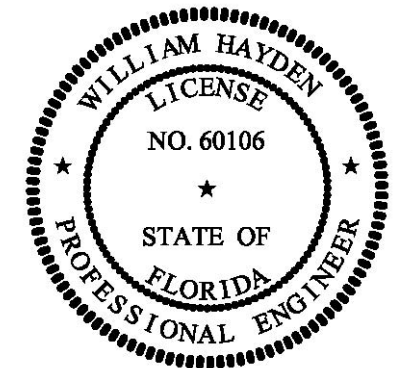
3.2.3.3.1 Deck Plating

h 8 ft  
s 24 inches

$$t = \frac{s\sqrt{h}}{460} + 0.10 \text{ in}$$

Deckplate  $t_{req.}$ : 0.248 in.

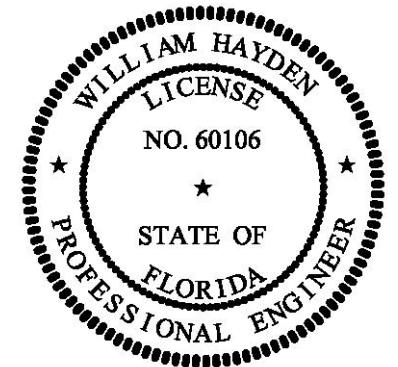
Deckplate  $t_{act.}$ : 0.25 in.



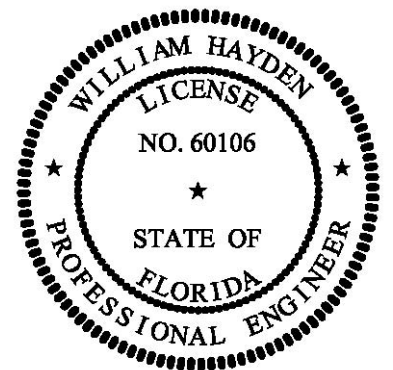
3.2.4.5.3 Bottom Long. Girders		SM = 0.0041chsℓ <sup>2</sup>					
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
Long. Hull Girders Fr 10 to 17 P & S	12.00 ft	6.50 ft	5.00 ft	0.915	17.56 IN^3	58.60 IN^3	16x5x3/8" flg pl on 60t 1/2" pl bottom
	Height <sub>min.</sub> :	21.00 in.					
	Height <sub>actual.</sub> :	16.00 in.					
	Thk <sub>min.</sub> :	0.330 in.					
	Thk <sub>actual.</sub> :	0.375 in.					
	MOI <sub>required.</sub> :	254.678 in.^4					
	MOI <sub>actual.</sub> :	261.000 in.^4					

3.2.4.3.7 Bottom Frames		SM = 0.0041chsℓ <sup>2</sup>					
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
typ. Xverse Bottom Frames	10.00 ft	6.50 ft	2.00 ft	0.5	2.67 IN^3	5.49 IN^3	5x3x1/4" L on 60t 3/8" pl

3.2.5.1 Side Frames		SM = 0.0041chsℓ <sup>2</sup>					
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
Typ. Xverse side Frames	6.50 ft	3.25 ft	2.00 ft	0.915	1.03 IN^3	5.36 IN^3	5x3x1/4" L on 60t 5/16" pl



3.2.6.1.3 Deck Girders & Transverses		SM = 0.0041chsℓ <sup>2</sup>			k: 0.239663591		
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
Long. Deck Girders Fr 10 to 17 P & S	8.00 ft	8.00 ft	5.00 ft	0.64	6.76 IN^3	12.00 IN^3	6x4x3/8" L on 60t 1/4" pl
Xverse Deck Beams typ.	10.00 ft	8.00 ft	2.00 ft	0.6	3.94 IN^3	5.20 IN^3	5x3x1/4" L on 60t 1/4" pl
3.2.6.5.3 Stanchion Permissible Load		W <sub>a</sub> = (k-nℓ/r)A					
LOCATION:	LENGTH:	k	n	r	A	W <sub>a</sub> :	
2.0" sched 80 stanchions @ fr 13	5.00 ft	7.83	0.345	0.77	1.48 IN^2	8.26 LT	
3.2.6.5.5 Calculated Load:		n	b	h	s	W:	
2.0" sched 80 stanchions @ fr 13	0.02 ft	5.00 ft	8.00 ft	6.00 ft		4.80 LT	

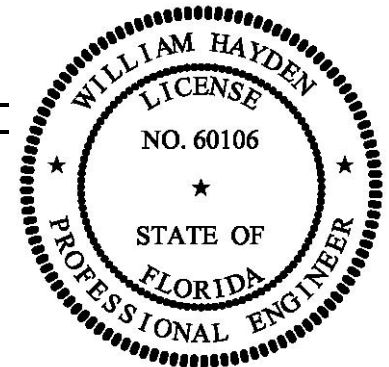


3.2.7.5.1 Watertight Bulkhead Plating		$t = sk\sqrt{gh}/c + 0.06$
s	18 in.	
k	1.00	
$\alpha$	6.00	
q	0.94	
y	36000 psi	
h	8.00 ft	
t <sub>req.</sub> :	0.17 in.	
t <sub>actual.</sub> :	0.31 in.	

3.2.7.5.1 Watertight Bulkhead Stiffeners		$SM = 0.0041chs\ell^2$					
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
W.T. bhds stiffeners	6.50	4.00 ft	1.50 ft	0.46	0.48 IN^3	1.90 IN^3	3x2x1/4" L on 60t 5/16" pl bhd

3.2.8.5.1 Deep Tank Bulkhead Plating		$t = sk\sqrt{gh}/c + 0.06$
s	18 in.	
k	1.00	
$\alpha$	3.00	
q	0.94	
y	36000 psi	
h	8.00 ft	
t <sub>req.</sub> :	0.17 in.	
t <sub>actual.</sub> :	0.31 in.	

3.2.7.5.3 Deep Tank bhd Stiffeners		$SM = 0.0041chs\ell^2$					
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
FO Tanks & Lube Oil Tanks	6.00	8.00 ft	1.50 ft	1	1.77 IN^3	1.90 IN^3	3x2x1/4" L on 60t 5/16" pl bhd



Vessel: **D&L#1393 45.5'x20'x6'-5" NCDOT Assist TowBoat** Job: **17-1393**

Author: **M. Jacob Connally**  
 date: **1/2/2019**  
 alt: **0**

Page: **1**

ABS 295' Rules		10.3 Material Q:	
3.2.9 Material Factors		10.3 Material Q:	
10.3 Material Q <sub>0</sub> :		10.3 Material Q:	
$Q_0 = 92000 / (Y_{al} + U_{al})$		$Q = 0.9 + (17000 / Y_{al})$	
<u>5086 plate</u>		<u>5086 plate</u>	
U <sub>al (5086)</sub> =	35000 psi	U <sub>al (5086)</sub> =	35000 psi
Y <sub>al (5086)</sub> =	14000 psi	Y <sub>al (5086)</sub> =	14000 psi
Q <sub>0</sub> =	<b>1.88</b>	Q=	<b>2.11</b>
<u>6061 plate</u>		<u>6061 plate</u>	
U <sub>al (6061)</sub> =	24000 psi	U <sub>al (6061)</sub> =	24000 psi
Y <sub>al (6061)</sub> =	15000 psi	Y <sub>al (6061)</sub> =	15000 psi
Q <sub>0</sub> =	<b>2.36</b>	Q=	<b>2.03</b>

L	45.5 ft	T <sub>req. Front bhds:</sub>	0.22 in.
s	1 ft		
l	8	T <sub>req. Side bhds:</sub>	0.17 in.
h	<b>1.89</b> ft		
a	0.59248	T <sub>req. Deck Plating:</sub>	0.24 in.
b	1.00		
Cb	0.8		
x	20 ft		
f	1.09		
y	6 ft		
c	0.65		
b1	10 ft		
B1	20 ft		

	x	y	h	b	s	l	Sm req'd:	Sm Actual:	
Main Dk Front Bhd Stiffeners	28	6.5	2.70	1.22	1	7.5	0.60	1.95	3x2x3/16" L on 38t 1/4" pl
Main Dk Front Bhd Mullions	28	6.5	2.70	1.22	2	7.5	1.19	2.44	3x3x1/4" sq. tube on 38t 1/4" pl
Main Dk Side Bhd Stiffeners	24	6.5	2.70	1.00	1	7.5	0.60	1.95	3x2x1/4" L on 38t 1/4" pl
Main Dk Side Bhd Mullions	24	6.5	2.70	1.00	2	7.5	1.19	2.44	3x3x1/4" sq. tube on 38t 1/4" pl
			c	h	s	l	Sm req'd:	Sm Actual:	
Pilothouse Roof xverse Stiffs			1	2.66	1	4	0.370	1.9	3x2x3/16" L on 38t 1/4" pl

