

D&L#1372 70.5'x30'x11'-0" NCDOT Island Class TowBoat

Length-L=	70.50	ft
Beam-B=	30.00	ft
Depth-D=	11.00	ft
Draft for scantlings-(d)=	6.00	ft
Δ Disp. @ Scantling Draft =	220.00	lt
Beam _{wl} Δ(waterline beam @ max draft)=	28	ft
Disp. @ Max Draft ∇ (Volume) =	7700	ft ³
Max. spacing-Hull:	21.00	in
Max. spacing-Sideshell:	21.00	in
Max. -Main Deck:	21.00	in
C _b =	0.650	

Author: M. Jacob Connally
date: 7/13/2018
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 ₁ :	11.261
C ₂ :	0.000144
C _b :	0.75
(3-2-1/7.5) Q _{factor} :	1
SM _{min.} :	350.60 ft-in ²
SM _{act.} :	2528.33 ft-in ²
MOI _{min.} :	742.25 ft ² -in ²
MOI _{act.} :	13325.34 ft ² -in ²

D&L#1372 70.5' NCDOT TUG

HULL GIRDER SECTION MODULUS CALCULATION

Typical midship section:

Note: Y is to be taken from the Baseline

Item	Scantlings	Area in ²	Y (ft)	AY	AY ²	h (ft)	(Ah ²)/12	I-part (in ⁴)
Skeg Bottom	3/4" pl	21	0	0.00	0.00	0	0.00	0.95
Bottomshell	1/2" pl	149	0.33	49.17	16.23	0.58	4.18	3.25
Sideshell	1/2" pl	126	5.75	724.50	4165.88	10.33	1120.44	99303
Main Deck	3/8" pl	135	11	1485.00	16335.00	0.031	0.01	1.58
Long. Bhds	5/16" pl	79.4	5.75	456.55	2625.16	10.58	740.65	104186
Long Hull Girders	3/8" Flg Pl	24	1.25	30.00	37.50	1.25	3.13	50
Long. Deck Girders	6x4x3/8" L	7.22	10.67	77.04	821.99	0.5	0.15	25
Bottomshell long. stiff	5/16x3" FB Stiffs	11.25	0.33	3.71	1.23	0.25	0.06	9
Sideshell Long. Stiffs	5/16x3" FB Stiffs	13	5.75	74.75	429.81	0	0.00	
Deck Long. Stiffs	3/8x2 FB Stiffs	14.25	11	156.75	1724.25	0.16	0.03	4.75
TOTALS:		580.12		3057.47	26157.04		1868.64	1413.77

in²xft²

Deck Height ABL= ft.

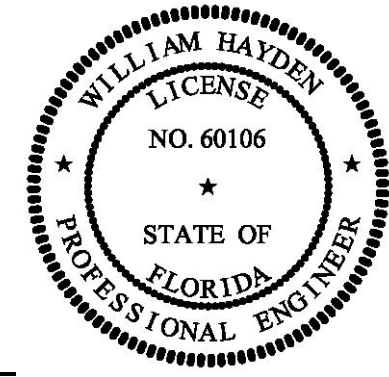
Neutral Axis = ft.

Depth - Neutral Axis = ft.

Inertia = in²ft²

Section Modulus (Bottom) = in²ft

Section Modulus (Top) = in²ft



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 $t_{req.}$: 0.221 in.

3.3.2 Bottomshell $t_{req.}$: 0.142 in.

Bottomshell $t_{act.}$: 0.5 in.

3.2.1.5.1 Sideshell Plating

3.5.1

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

Sideshell $t_{req.}$: 0.2436 in.

Sideshell $t_{act.}$: 0.5 in.

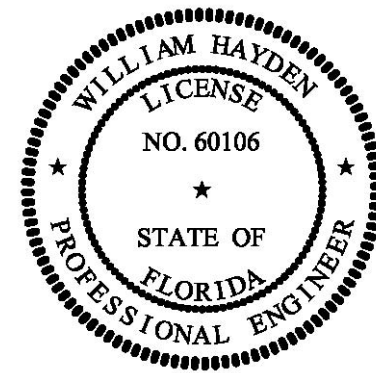
3.2.3.3.1 Deck Plating

h 12 ft
s 21 inches

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

Deckplate $t_{req.}$: 0.258 in.

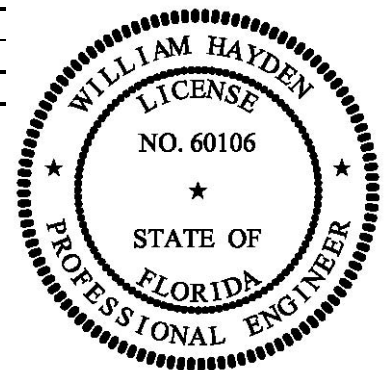
Deckplate $t_{act.}$: 0.375 in.



3.2.4.5.3 Bottom Long. Girders		SM = 0.0041chsℓ ²					
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
Long. Hull Girders Fr 10 to 18 P & S	12.00 ft	11.00 ft	6.75 ft	0.915	40.11 IN ³	64.00 IN ³	17.5x5x3/8" flg pl on 60t 1/2" pl bottom
	Height _{min} :	21.00 in.					
	Height _{actual} :	17.50 in.					
	Thk _{min} :	0.330 in.					
	Thk _{actual} :	0.375 in.					
	MOI _{required} :	254.678 in. ⁴					
	MOI _{actual} :	268.000 in. ⁴					

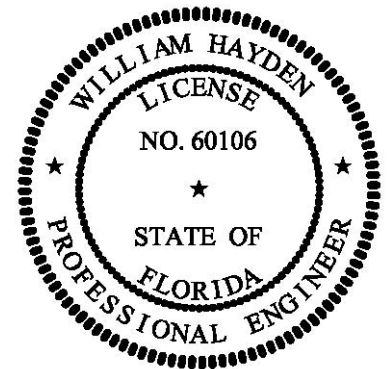
3.2.4.3.7 Bottom Floors Frs 20-30		SM = 0.0041chsℓ ²					
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
typ. Xverse Floors Engine Room Fr 20 to 32	20.00 ft	7.26 ft	3.00 ft	0.5	17.86 IN ³	37.16 IN ³	5/16" pl w/4" flg on 60t 1/2" pl bottom
	Height _{min} :	15.00 in.					
	Height _{actual} :	16.00 in.					
	Thk _{min} :	0.270 in.					
	Thk _{actual} :	0.313 in.					
	MOI _{required} :	75.938 in. ⁴					
	MOI _{actual} :	92.000 in. ⁴					

3.2.5.1 Side Frames		SM = 0.0041chsℓ ²					
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
Typ. Xverse side Frames	9.25 ft	5.75 ft	3.00 ft	0.915	5.54 IN ³	14.10 IN ³	8x3x5/16" Ring Frame



3.2.6.1.3 Deck Girders & Transverses							
SM = 0.0041chsℓ ²				k: 0.150748255			
LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
Long. Deck Girders Fr 10 to Transom P & S	7.00 ft	12.00 ft	7.00 ft	0.62	10.48 IN ³	12.00 IN ³	6x4x3/8" L on 60t 3/8" pl
Long. Deck Stiifs-typ. On 21" cntrs	3.00 ft	12.00 ft	1.75 ft	0.7	0.54 IN ³	0.63 IN ³	3/8x2" f.b. on 60t 3/8" pl
Xverse Deck Beams Fr. 2->6	8.75 ft	12.00 ft	3.00 ft	0.6	6.78 IN ³	8.52 IN ³	6x3x5/16" L on 60t 3/8" pl
Xverse Deck Beams Fr. 12->24	8.00 ft	12.00 ft	3.00 ft	0.6	5.67 IN ³	6.64 IN ³	5x3x5/16" L on 60t 3/8" pl
Xverse Deck Beams Fr. 26 & 30	8.00 ft	12.00 ft	4.50 ft	0.6	8.50 IN ³	12.00 IN ³	6x4x3/8" L on 60t 3/8" pl

3.2.6.5.3 Stanchion Permissible Load							
$W_a = (k-n\ell/r)A$							
LOCATION:	LENGTH:	k	n	r	A	W _a :	
2.5" sched 80 stanchions @ fr 14,22,26,30,36,43	8.75 ft	7.83 ft	0.345 ft	0.92	2.25 IN ²	10.27 LT	
3.2.6.5.5 Calculated Load:							
	n	b	h	s		W:	
2.5" sched 80 stanchions @ fr 14,22,26,30,36,43	0.02 ft	6.00 ft	12.00 ft	6.00 ft		8.64 LT	



3.2.7.5.1 Watertight Bulkhead Plating

$$t = sk\sqrt{gh}/c + 0.06$$

s	16 in.
k	1.00
α	6.00
q	0.94
y	36000 psi
h	12.00 ft
t _{req.}	0.18 in.
t _{actual.}	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	11.00	6.00 ft	1.50 ft	0.46	2.05 IN^3	3.30 IN^3	3x3x5/16" L on 60t 5/16" pl bhd

3.2.8.5.1 Deep Tank Bulkhead Plating

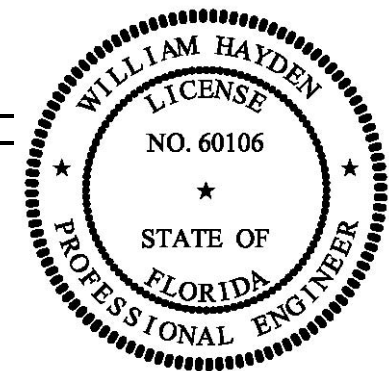
$$t = sk\sqrt{gh}/c + 0.06$$

s	18 in.
k	1.00
α	3.00
q	0.94
y	36000 psi
h	14.00 ft
t _{req.}	0.20 in.
t _{actual.}	0.31 in.

3.2.7.5.3 Deep Tank bhd Stiffeners

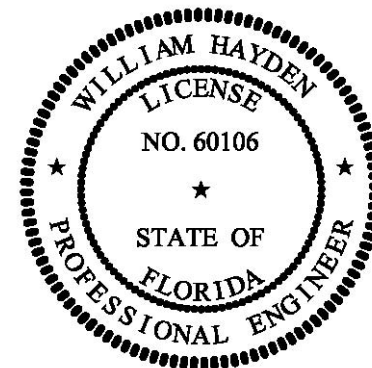
$$SM = 0.0041chs\ell^2$$

LOCATION:	LENGTH:	H:	S:	C:	SM REQ. :	SM ACTUAL:	STRUCTURAL MEMBER USED:
FO Tanks & Lube Oil Tanks	11.00	7.00 ft	1.50 ft	1	5.21 IN^3	6.43 IN^3	5x3x5/16" L on 60t 5/16" pl bhd



Vessel: D&L#1372 64.5'x26'x9'-0" NCDOT Island Class TowBoat	Job: 17-1372	Author: M. Jacob Connally
		date: 8/15/2018
		alt: 0

ABS 295' Rules	
3.2.9 Material Factors	
10.3 Material Q₀:	
$Q_0 = \frac{92000}{(Y_{al} + U_{al})}$	10.3 Material Q:
<u>5086 plate</u>	$Q = 0.9 + \left(\frac{17000}{Y_{al}}\right)$
U _{al (5086)}} = 35000 psi	<u>5086 plate</u>
Y _{al (5086)}} = 14000 psi	U _{al (5086)}} = 35000 psi
Q ₀ = 1.88	Y _{al (5086)}} = 14000 psi
<u>6061 plate</u>	Q= 2.11
U _{al (6061)}} = 24000 psi	<u>6061 plate</u>
Y _{al (6061)}} = 15000 psi	U _{al (6061)}} = 24000 psi
Q ₀ = 2.36	Y _{al (6061)}} = 15000 psi
	Q= 2.03



L	66 ft	$T_{req.}$ Front bhds:	0.22 in.
s	1 ft		
l	8	$T_{req.}$ Side bhds:	0.17 in.
h	2.76 ft		
a	0.634146	$T_{req.}$ Deck Plating:	0.25 in.
b	1.00		
Cb	0.8		
x	30 ft		
f	2.95		
y	9 ft		
c	0.72		
b1	18 ft		
B1	30 ft		

	x	y	h	b	s	l	Sm req'd:	Sm Actual:	
Main Dk Front Bhd Stiffeners	55	9.5	2.70	1.22	1	7.75	0.64	1.95	3x2x3/16" L on 38t 1/4" pl
Main Dk Front Bhd Mullions	55	9.5	2.70	1.22	2.5	7.75	1.59	2.44	3x3x3/16" sq. tube on 38t 1/4" pl
Main Dk Side Bhd Stiffeners	30	9.5	2.70	1.00	1	7.75	0.64	1.95	3x2x3/16" L on 38t 1/4" pl
Main Dk Side Bhd Mullions	30	9.5	2.70	1.00	2.5	7.75	1.59	2.44	3x3x3/16" sq. tube on 38t 1/4" pl
2nd Dk Front & Side bhdStiffeners	30	18.5	2.70	1.00	1	7.75	0.64	1.95	3x2x3/16" L on 38t 1/4" pl
2nd Dk Front & Side Bhd Mullions	30	18.5	2.70	1.00	2.5	7.75	1.59	2.44	3x3x3/16" sq. tube on 38t 1/4" pl

	c	h	s	l	Sm req'd:	Sm Actual:	
2nd Deck Xverse Stiffeners	1	2.66	1	6.67	1.030	1.95	3x2x1/4" L on 38t 1/4" pl
2nd Deck Long. Girders	1	2.66	4.5	9.67	9.743	10.71	6x4x3/8" L on 38t 1/4" pl
3rd Deck Long. Girders	1	2.66	4.5	9.67	9.743	10.71	6x4x3/8" L on 38t 1/4" pl
2nd Deck Xverse Stiffeners	1	2.66	1	7.5	1.302	1.95	3x2x1/4" L on 38t 1/4" pl
Pilohouse Roof xverse Stiffs	1	2.66	1	12	3.334	3.77	4x3x1/4" L on 38t 1/4" pl

	h (ft):	S (in.)	L (in.)	All. (PSI)	end cond.	SM req'd:	Sm Actual	
2nd dk aft cantilever beams	2.66	12	78	9500	2	4.543	5.08	6x2x3/8" tapered beams on 38t 1/4" pl

