Stress Skin Structural Analysis Worksheet

Panel Description: For Rosencrantz and Guildenstern- Two 3ft x 10ft panels each with 5/8" top ply and 3/8" bottom ply and 3 stringers each.

	= User Defined Data

Panel Information				
Span Length =	10	ft.		
Panel Width =	36	in.	3	ft.
# of Stringers =	3			
# of Spans =	2			
Str. Width =	1.5	in.		
Str Height =	3.375	in.		
Top Skin Heignt	0.625	in.		
Bottom Skin Height	0.375	in.		
Total Panel Height	4.375	in.		
Deflection Criteria	240			
Allowable Tensile Stress for tension splice plate	1200	psi		
Number of Interior Stringers	1			
Number of Exterior Stringers	2			
Dist. From nearest end of panel to splice plate	2	ft.		

Top Skin-	5/8" Rtd Sheathing Exp 1, group 1, grade stress level S-2, Unsanded		
Section Properties		Allowable Stress	
Area =	2.33	$F_{t/}\ F_b$ =	1650
I- (in^4/ft) =	0.121	F_c =	1540
I_x- (in^4/ft) =	0.010	F_s =	53
(For Q's) y' (in)=	0.0580	E=	1800000

(For Q's) A (in^2)=	4.64	

Bottom Skin-	3/8" Rtd Sheathing, Exp 1, Group 1, Grade Stress Level S-2, Unsanded		
Section Properties		Allowable Stress	
Area =	1.866	$F_{t/}$ F_b =	1650
I- (in^4/ft) =	0.039	F_c =	1540
$I_{.}$- (in^4/ft) =	0.002	F_s =	53
		E=	1800000

Stringers (str)-	2x4 Spruce-Pine-Fir No.2		
Section Properties		Allowable Stress	
Area $_{x-x}$ =	5.0625	F_v =	70
I $_{x-x}$ =	4.8054199	E =	1400000

Basic Spacing	
Top Skin	23
Bottom Skin	14

Calculation

Clear Distance =	$\frac{\text{panel width- (\# of Str)(str width)}}{\text{number of spans}}$	=	15.75	in.

Total Spice Plate =	30.5	in.

E_{Lply} =	1980000	psi
E_{Lstr} =	1442000.00	psi

NA: Bottom to mid btm skin	0.1875	in.
NA: Bottom to Mid STR.	2.0625	in.
NA: Bottom to Mid Top Skin	4.0625	in.

Calculate Neutral Axis for Deflection					
	Area in^2	E_L PSI	AE_L	Y in.	AE_LY
Top Skin	6.99	1980000	13840200	4.0625	56225812.5
Bottom Skin	5.598	1980000	11084040	0.1875	2078257.5
Stringers	15.1875	1442000	21900375	2.0625	45169523.438
Sum:			46824615		103473593.438

$$Y = \frac{\sum AE_LY}{\sum AE_L} = 2.2098119$$

N.A. for deflec. to bottom	2.2098119	in.
N.A. for deflec. To middle str.	0.1473119	in.
N.A. for deflec. To middle top skin	1.8526881	in.
N.A. for deflec. To middle of btm skin	2.0223119	in.

Calculate Gross Stiffness Factor						
	I_o in^4	Area in^2	d in.	$I_g = I_o + Ad^2$	E_L PSI	$E_L I_g$
Top Skin	0.363	6.99	1.8526881	24.355847	1980000	48224577
Bottom Skin	0.117	5.598	2.0223119	23.011396	1980000	45562564
Stringers	14.41626	15.1875	0.1473119	14.745841	1442000.000	21263502
Sum:						115050643

Allowable load due to deflection			
G: Modulous of Rigidity for Str.			
$G = .06(E_{LSTR})$	=	86520	psi

$$w_\Delta = \frac{1}{CL[7.5L^2/E_L I_g + .6/AG]} = 59.73303221 \text{ psf}$$

Allowable load due to deflection in top skin				
$W_{\Delta(ts)} = \frac{384EI_4 12\Delta_{all}}{I_4}$	=	88.45697	psf	

Allowable Load due to bending				
Effective Width Bottom Skin	=	32.5		
$A_{bending} = (A)\frac{\text{Eff Width}}{\text{Panel Width}}$	=	5.05375		
$I_{obending} = (I_o)\frac{\text{eff. width}}{\text{panel width}}$	=	0.105625		

	Area in^2	E_L PSI	AE_L	Y in.	$AE_L Y$

Top Skin	6.99	1980000	13840200	4.0625	56225812.5
Bottom Skin	5.05375	1980000	10006425	0.1875	1876204.688
Stringers	15.1875	1442000	21900375	2.0625	45169523.44
Sum:			45747000		103271540.6

$$Y = \frac{\sum AE_L Y}{\sum AE_L} = 2.2574495$$

N.A. for bending to bottom	2.2574495	in.
N.A. for bending To middle str.	0.1949495	in.
N.A. for bending To middle top skin	1.8050505	in.
N.A. for bending To middle bottom skin	2.0699495	in.
N.A. for bending to top of top skin	2.1175505	in.

	I_o in^4	Area in^2	d in.	$I_n = I_o + Ad^2$	E_L PSI	$E_L I_n$
Top Skin	0.363	6.99	1.8050505	23.13787	1980000	45812983
Bottom Skin	0.105625	5.05375	2.0699495	21.759381	1980000	43083574
Stringers	14.41626	15.1875	0.1949495	14.993465	1442000.000	21620577
Sum:						110517134

Allowable Stress

Top Skin				
Factor	=	1- ((CD/Bdist. - .5)2/3)	=	0.876811594
F_C'	=	factor(F_C)	=	1350.2899 psi

Bottom Skin				
Factor	=	(CD/Bdist.)	=	1.125
If >1 Then:				
F_t'	=	.667(F_t)	=	1100.55 psi

$$W_{bt} = \frac{8F_c'(E_L I_n)}{48cL^2E_L} = 59.320717 \text{ psf}$$

$$W_{bb} = \frac{8F_c'(E_L I_n)}{48cL^2E_L} = 45.352884 \text{ psf}$$

Allowable Load Due to Tension in Top Plate

$$W_p = \frac{8F(\text{Total Splice Plate/Bottom Skin Width})(E_L I_g)}{48\ cL^2E_L} = 44.555 \text{ psf}$$

Allowable Load Due to Tension in Top Plate when moving splice plate

$$W_{padjusted} = \frac{2F(\text{Total Splice Plate/Bottom Skin Width})(E_L I_g)}{48\ cX(L-X)E_L} = 69.617 \text{ psf}$$

Allowable Load due to rolling Shear stress

C	=	2.1651881			
d_s	=	c-y'	=	2.1071881	in
Q_s	=	Ad_s	=	9.7773526	in^3 per panel width

$$\Sigma F_s t = [(Fs/2)(\#\text{of ext Stringers})+((Fs)(\#\text{ of Interior Stringers})(t)) = 159 \text{ inlb.}$$

$$w_s = \frac{2(E_L I_g)\Sigma F_s t}{4Q_s L E_L} = 47.246508 \text{ psf}$$

Allowable Load due to horizontal Shear

A_{str} above N.A.	=	bd	=	2.3102821	in^3
Q_{str}	=	Ad	=	1.7791344	in^3
Qskin	=	Ad	=	12.95029	in^3

$$Q_v = (\#\text{ of Stringers})(Q_{str})+(E_{Lskin}/E_{Lstr})(Q_{skin}) = 23.119 \text{ } in^3$$

$$w_v = \frac{2(E_L I_g)F_v t}{4Q_v L E_{Lstr}} = 54.353642 \text{ psf}$$

Compare Allowable Loads

w_Δ	=	59.733032	psf
$W_{\Delta(ts)}$	=	88.45697	psf

W_{bt}	=	59.320717	psf
W_{bb}	=	45.352884	psf
W_{p}	=	44.554941	psf
w_{s}	=	47.246508	psf
w_{v}	=	54.353642	psf
$W_{Padjusted}$	=	69.617096	psf

The Panel is Rated for:	