Stress Skin Structural Analysis Worksheet

Panel Description: For Marisol- One 11'x 3'-4" stress skin panel with 5/8" top ply, 3/8" bottom ply and 4 stringers.

	= User Defined Data

Panel Information				
Span Length =	11	ft.		
Panel Width =	40	in.	3.3333333	ft.
# of Stringers =	4			
# of Spans =	3			
Str. Width =	1.5	in.		
Str Height =	3.25	in.		
Top Skin Heignt	0.625	in.		
Bottom Skin Height	0.375	in.		
Total Panel Height	4.25	in.		
Deflection Criteria	240			
Allowable Tensile Stress for tension splice plate	1200	psi		
Number of Interior Stringers	2			
Number of Exterior Stringers	2			

Top Skin-	** Panel Description**		
Section Properties		Allowable Stress	
Area =	2.33	F_t/ F_b =	1650
I- (in^4/ft) =	0.121	F_c =	1540
I- (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-	** Panel Description **		
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)-	** Stringer Description **		
Section Properties		Allowable Stress	
Area $_{x-x}$ =	4.875	F_v =	70
I $_{x-x}$ =	4.2910156	E =	1200000

Basic Spacing	
Top Skin	22
Bottom Skin	17

Calculation

Clear Distance =	$\frac{\text{panel width- (\# of Str)(str width)}}{\text{number of spans}}$	=	11.33333333	in.

Total Spice Plate =	32.5	in.

E_{Lply} =	1980000	psi
E_{Lstr} =	1236000.00	psi

NA: Bottom to mid btm skin	0.1875	in.
NA: Bottom to Mid STR.	2	in.
NA: Bottom to Mid Top Skin	3.9375	in.

Calculate Neutral Axis for Deflection					
	Area in^2	E_L PSI	AE_L	Y in.	AE_LY
Top Skin	7.7666667	1980000	15378000	3.9375	60550875
Bottom Skin	6.22	1980000	12315600	0.1875	2309175
Stringers	19.5	1236000	24102000	2	48204000.000
Sum:			51795600		111064050.000

$$Y = \frac{\sum AE_LY}{\sum AE_L} = 2.1442758$$

N.A. for deflec. to bottom	2.1442758	in.
N.A. for deflec. To middle str.	0.1442758	in.
N.A. for deflec. To middle top skin	1.7932242	in.
N.A. for deflec. To middle of btm skin	1.9567758	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	0.4033333	7.7666667	1.7932242	25.378239	1980000	50248914
Bottom Skin	0.13	6.22	1.9567758	23.946202	1980000	47413480
Stringers	17.164063	19.5	0.1442758	17.569965	1236000.000	21716476
Sum:						119378871

Allowable load due to deflection

G: Modulous of Rigidity for Str.

$G = .06(E_{LSTR})$ = 74160 psi

$$w_\Delta = \frac{1}{CL[7.5L^2/E_L I_g + .6/AG]} = 47.24954972 \text{ psf}$$

Allowable load due to deflection in top skin

$$W_{\Delta(ts)} = \frac{384EI_{.}12\Delta_{all}}{I_4} = 237.41095 \text{ psf}$$

Allowable Load due to bending

Effective Width Bottom Skin	=	57			
$A_{bending}$	=	(A) $\frac{\text{Eff Width}}{\text{Panel Width}}$	=	8.8635	
$I_{obending}$	=	(I_o) $\frac{\text{eff. width}}{\text{panel width}}$	=	0.18525	

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

Top Skin	7.7666667	1980000	15378000	3.9375	60550875
Bottom Skin	8.8635	1980000	17549730	0.1875	3290574.375
Stringers	19.5	1236000	24102000	2	48204000
Sum:			57029730		112045449.4

$$Y = \frac{\sum AE_L Y}{\sum AE_L} = 1.9646849$$

N.A. for bending to bottom	1.9646849	in.
N.A. for bending To middle str.	-0.035315	in.
N.A. for bending To middle top skin	1.9728151	in.
N.A. for bending To middle bottom skin	1.7771849	in.
N.A. for bending to top of top skin	2.2853151	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	0.4033333	7.7666667	1.9728151	30.631195	1980000	60649767
Bottom Skin	0.18525	8.8635	1.7771849	28.179606	1980000	55795619
Stringers	17.164063	19.5	-0.0353151	17.188382	1236000.000	21244840
Sum:						137690227

Allowable Stress

Top Skin				
Factor	=	1- ((CD/Bdist. - .5)2/3)	=	0.98989899
F_C'	=	factor(F_C)	=	1524.4444 psi

Bottom Skin				
Factor	=	(CD/Bdist.)	=	0.666666667
If >1 Then:				
F_t'	=	.667(F_t)	=	1100.55 psi

$$W_{bt} = \frac{8F_c'(E_L I_n)}{48cL^2E_L} = 63.894992 \text{ psf}$$

$$W_{bb} = \frac{8F_c'(E_L I_n)}{48cL^2E_L} = 53.655985 \text{ psf}$$

Allowable Load Due to Tension in Top Plate

$$W_p = \frac{8F(\text{Total Splice Plate/Bottom Skin Width})(E_L I_g)}{48\, cL^2E_L} = 37.762 \text{ psf}$$

Allowable Load due to rolling Shear stress

C	=	2.1057242			
a_s	=	c-y'	=	2.0477242	in
Q_s	=	Ad_s	=	9.5014404	in^3 per panel width

$$\sum F_s t = ((Fs/2)(\#\text{of ext Stringers}))+((Fs)(\#\text{ of Interior Stringers})(t)) = 238.5 \text{ inlb.}$$

$$w_s = \frac{2(E_L I_g)\sum F_s t}{4Q_s L E_L} = 68.792094 \text{ psf}$$

Allowable Load due to horizontal Shear

A_{str} above N.A.	=	bd	=	2.2210863	in^3
Q_{str}	=	Ad	=	1.6444082	in^3
Qskin	=	Ad	=	13.927375	in^3

$$Q_v = (\#\text{ of Stringers})(Q_{str})+(E_{Lskin}/E_{Lstr})(Q_{skin}) = 28.888 \text{ } in^3$$

$$w_v = \frac{2(E_L I_g)F_v t}{4Q_v L E_{Lstr}} = 63.827961 \text{ psf}$$

Compare Allowable Loads

w_Δ	=	47.24955	psf
$W_{\Delta(ts)}$	=	237.41095	psf
W_{bt}	=	63.894992	psf
W_{bb}	=	53.655985	psf
W_p	=	37.761534	psf
w_s	=	68.792094	psf

w_v	=	63.827961	psf

The Panel is Rated for:	