QC
Avro
CF105
R-7-0583-8

AVRO AIRCRAFT

TECHNICAL REPORT

ANALYZED

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C105

REPORT NO: 7/0583/9

FILE NO:

NO. OF SHEETS:

TITLE:

SPAR, RIB & SKIN STRESSES

CONFIDENTIAL

Classification cancelled / Changed to UNCLASS
By authority of AVRS
Date 30 Sept 96
Signature [signature]
Unit / Rank / Appointment AVRS 5

NRC - CISTI
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AÉRO / G.M.
CNRC - ICIST

PREPARED BY L. MATALON, J. DIXON DATE 16 MAY 1957

CHECKED BY DATE

SUPERVISED BY DATE

APPROVED BY DATE

ISSUE No	REVISION No	REVISED BY	APPROVED BY	DATE	REMARKS
					15867290

FORM 1316A

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/0322/8 SHEET No. 0-1	
		PREPARED BY	DATE
AIRCRAFT: C105	FIN	J. L. Dixon	16 MAY 195[illegible]
		CHECKED BY	DATE

INDEX.

CONFIDENTIAL

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C105	FIN SPAR, RIB & SKIN STRESSES	REPORT NO. 7-0583-8 SHEET NO. 0-2	
		PREPARED BY: S. L. DIXON	DATE: 16 MAY '55
		CHECKED BY:	DATE:

IN THE FOLLOWING ANALYSIS SECTIONS 1, 2, & 3 ARE PRELIMINARY CALCULATIONS AND THE RESULTS OBTAINED WERE USED TO ESTABLISH BASIC FIGURES FOR THE SPAR & RIB SIZES AND THE TYPES OF ATTACHMENTS TO BE USED.

THESE SIZES ETC., ARE NOT FINAL & WILL BE CHECKED LATER IN THE DETAIL STRESSING

NOTE :-

SECTIONS 1, 2 & 3 OF THIS REPORT ARE, VERY EARLY, DIFFICULT TO FOLLOW AND GENERALLY UNSATISFACTORY.

ATTEMPTS HAVE BEEN MADE IN REPORTS 7/0583/16 & 17 TO PRODUCE LOGICAL REPORTS ON SHEAR AND END LOAD DISTRIBNS OVER THE FIN AND THESE REPORTS USE ENGINEERS THEORY AND THE EARLY MATRIX FOR THE ROOT OF THE FIN.

THE NEW FIN MATRIX ANALYSIS WILL GIVE RESULTS WHICH WILL BE USED FOR FINAL STRESSING.

J. D. O'DOHERTY
3-10-56

AVRO AIRCRAFT LIMITED
MALTON - ONTARIO
TECHNICAL · DEPARTMENT

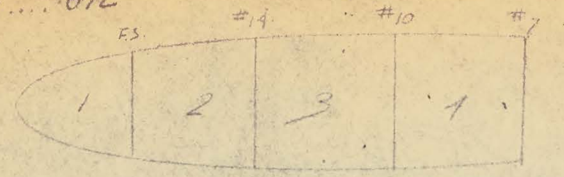
AIRCRAFT: C.105.	FIN.	REPORT NO. 7/0583/8. SHEET NO. SECTION. 1. SHT. 0
		PREPARED BY / DATE
		CHECKED BY / DATE

PRELIMINARY DETERMINATION OF RIB GAUGES.

RM 1319A

FIN CP AFT RIB -23.0

RIB GAUGE .... .072



A. V. RO[illegible]

AIRCRAFT

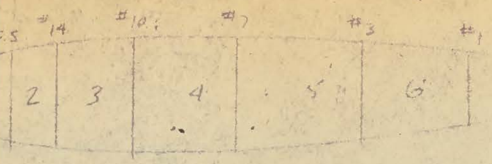
WEIGHT

C. G. POSI[illegible]

BAY #	1 SKIN THICKNESS	2 A AREA t× #14	3 h AD	4 Ah^2	5 $\frac{bd^3}{12}$	6 I [illegible]	7 y	8 M (MAX)	9 [illegible] $\frac{M}{I}$	10 AVERAGE τ lb/□"	11 [illegible]
2	.099	2.871	3.250	30.34	.0023	60.684	3.30	5,800	315	200/t	6.0[illegible]
3	.109	3.161	3.895	48.00	.0031	96.006	3.95	52,750	2170	400/t	6.0[illegible]
4	.178	2.581	4.081	42.99	.0068	85.914	4.17	52,750	2561	65/t	6.00[illegible]
	.00064 (15) using t = .040	.0016 (16) using t = .040	.0001219 (15) using t = .051	.0026 (16) using t = .051	.000262 (15) using t = .064	.0041 (16) using t = .064	[illegible]	.000131 15 using t = .081	.0042 (16) using t = .081		
2			.839	.0262							
3					.845	.088		.417	.055		
4	.577	.267									
					USING	.081	FOR	S FOR	BAY	#3 =	1.00/[illegible]
					using	.09				#3 =	1.00/3[illegible]

RIB 6.0

.81



A. V. ROE CANADA LIMITED

MALTON, ONTARIO

TECHNICAL DEPT. (AIRFRAME)

AIRCRAFT - - C 105

WEIGHT - -

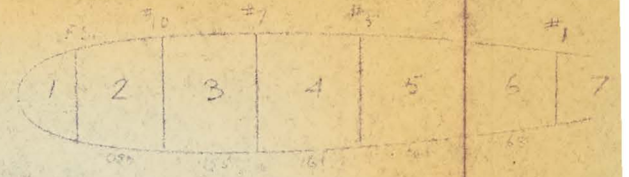
C. G. POSITION - -

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
…NESS	A AREA T×23.50	h (A.I)	Ah^2	$\frac{bd^3}{12}$	I	y	M (MAX)	$\sigma = \left(\frac{My}{I}\right)$	AVERAGE τ lb/in²	b	b^2	τ_{cr} $\frac{6.5\times10^7}{b^2}$	σ_b $\frac{21.6\times10^7}{b^2}$	
	2.032	2.625	14.42	.0014	28.843	2.67	4000	370	320/t	5.162	26.647	$.2439\ t^2$	$.812\ t^2$	$1312\ t^{-3}$
	2.306	3.320	25.42	.0019	50.844	3.32	63,000	4,175	270/t	6.00	36.0	$.1806\ t^2$	$.601\ t^2$	$1495\ t^{-3}$
	3.947	3.726	54.90	.0080	109.816	3.81	63,000	2,135	85/t	6.00	36.0	$.1806\ t^2$	$.601\ t^2$	$3670\ t^{-3}$
	4.090	3.503	50.13	.0103	100.251	3.39	60,000	2,106	95/t	6.00	36.0	$.1806\ t^2$	$.601\ t^2$	$526\ t^{-3}$
	4.250	2.990	38.00	.0116	76.023	3.08	154,000	6,235	102/t	5.738	32.628	$.1934\ t^2$	$.643\ t^2$	$5300\ t^{-3}$
…40	(16) using t = .080	(15) using t = .051	(16) using t = .051	(15) using t = .064	(16) using t = .069	(15) using t = .072	(16) using t = .072	(15) using t = .081	.00656 (16) using t = .081	.000754 t = .091	.00829 (16) using t = .091			
		.996	.0175											
				.570	.170									
						.983	.070							
	.223													
								.998	.148					
								F of S. ON BAY #6 = $\frac{1.00}{.998} - 1$ = .002						

FIN CP AFT. RIB 420

RIB GAUGE — ·072

L = 215



BAY #	1 SKIN THICKNESS	2 A AREA (①×215)	3 h (AV)	4 Ah^2	5 $\frac{bd^3}{12}$	6 I [④+⑤]×4	7 y (AV)	8 M	9 σ = ($\frac{My}{I}$)	10 AVERAGE τ lb/t
2	·086	1·850	2·677	13·24	·0011	26·48	2·72	5741	58[illegible]	89/t
3	·155	3333	3·222	3458	·0067	69·17	3·30	10,111	48[illegible]	160/t
4	·161	3·460	3240	3635	·0075	72·72	3·32	43,411	1,99[illegible]	368/t
5	·161	3·460	3·020	31·57	·0075	63·16	3·10	7,516	3[illegible]	542/t
6	·168	3·610	2·666	25·67	·0085	51·36	2·75	10,059	53[illegible]	218/t

USING VALUES OF SHEAR & BENDING MOMENT OBTAINED FROM MATRIX —

	M(MAX)	σ ($\frac{My}{I}$)	AV τ	$R_T \times 10^4$	$R_B \times 10^2$		·000064 ① using t = ·090	·0046 ② using t = ·040	·000134 ③ using	·0026 ④ using t = ·051
2	19,200	1,438	60/t	256 t^{-3}	842 t		·400	·115		
3	15,000	715	120/t	608 t^{-3}	1303 t^{-2}		·950	082		
4	32,000	1,460	60/t	388 t^{-3}	2690 t^{-2}		575	·168		
5	31,000	1,521	325/t	1728 t^{-3}	2424 t^{-2}					
6	60,000	3,216	808/t	3376 t^{-3}	3350 t^{-2}					
							F of S FOR BAY 6 =			$\frac{1·09}{·883}$

FORM 1544

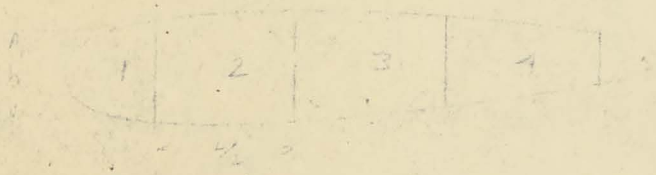
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
y	M	σ (M/Z)	AVERAGE τ lb/□"	b	b²	τcr 6.5×10[illegible]/b²	σc 2.16×10[illegible]/b²	Rc×10[illegible]	Rs×10[illegible]		SHEAR STRESS [illegible] lb/□"	(15) using t = .040	[illegible] using t = .040	(18) using t = .05[illegible]
2.72	5,241	58	89/t	5.268	27.752	.2344 t^2	.780 t^2	341.5 t^{-3}	755 t^{-2}		1,107	.534	.047	
3.30	10,11[illegible]	48	180/t	6.290	39.564	.1644 t^2	.547 t^2	212 t^{-3}	.881 t^{-2}		2,080	1.42		.687
2.32	43,[illegible]	1,95	168/t	6.318	39.918	.1630 t^2	.5425 t^2	2259 t^{-3}	3663 t^{-2}		5,110			[illegible]
3.10	7,514	3[illegible]	542/t	5.875	34.551	.1882 t^2	.6265 t^2	2890 t^{-3}	595 t^{-2}		7,550			
2.75	10,059	53	218/t	5.164	26.667	.2439 t^2	.812 t^2	894 t^{-3}	663 t^{-2}		3,035			.672
[illegible]BTAINED	FROM	MATRIX :-												
.000064 (4) using t = .040	.0016 (5) using t = .040	.000[illegible] (4) using t = [illegible]	.0026 (5) using t = .051	.000[illegible] (4) using t = .064	.0041 (5) using t = .064	.000973 (4) using t = .072	.0051[illegible] (5) using t = .072				MARGIN OF SA[illegible]			
.400	.115													
.950	.082													
.575	.168													
				.659	.059									
						.889	.076							
F OF S	FOR BAY 6	=	1.00/.889	− 1 =	.125									

6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I	y (in)	M (in lb)	[illegible]	Aσ/t lb/in	b	b^2	τ_{cr} $6.5\times10^7 / b \times 10^7$	σ_s $2165\times10^7 / b^2 \times10^7$	R_s	R_{s+c}		SHEAR STRESS lb/in²	[illegible]	[illegible]
14.23	1.71	13,048	1,302	263/t	3.178	10.099	$591\,t^2$	$2144\,t^2$	$445\,t^{-3}$	$848\,t^{-2}$		4,110	[illegible]	0[illegible]
23.9.1	2.15	106,848	9,[illegible]	570/t	4.046	16.371	$397\,t^2$	$1324\,t^2$	$1558\,t^3$	$7250\,t^{-2}$		9,930		
20.07	1.93	126,251	12,150	59[illegible]/t	3.592	12.903	$504\,t^2$	$1683\,t^2$	$595\,t^3$	72176		469	993	.4[illegible]
[illegible]	y (in)	M	σ	Aσ/t lb/in	b.	b^2	τ_{cr}	σ 2165×10^7	R_s	R_{s+c}				
10.45	1.39	9880	1,310	503/t	2.552	6.513	$998\,t^2$	$3323\,t^2$	$508\,t$	[illegible]		7990	780	0[illegible]
20.75	1.89	83,230	8,520	300/t	3.540	12.532	$519\,t^2$	$1729\,t^2$	$578\,t^3$	40100		4,690	903	2[illegible]
18.55	1.74	87,930	8,252	1165/t	3.224	10.394	$625\,t^2$	$2083\,t^2$	$1863\,t^3$	9,960		18,200		

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT No. 7/0[illegible]/8	
C105	FIN C.P. AFT RIB WEIGHT RIB - 23 Q	SHEET No. 1-8	
		PREPARED BY	DATE
		[illegible]	16 FEB [illegible]
		CHECKED BY	DATE



CELL	AREA	L	h	[illegible] STRUTS		[illegible]
1						
2	74.4	20.0	5.28	2 × .081 h =	.87	162 × 60 [illegible]
			6.94	3 × .081 h =	1.69	[illegible]
3	140.0	36.0				[illegible]
			7.96	3 × .081 h =	1.94	[illegible]
4	150.7	38.0				[illegible]
			7.97	1 × .081 h =	.65	[illegible]
5						
AREA	364.9	92.0				
VOL	29.65	7.45			5.15	

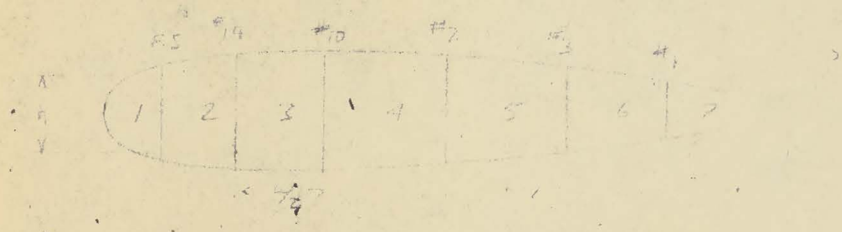
TOTAL VOL = 42.25

WEIGHT = 42.25 × [illegible] = [illegible]

= 4.97

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/0?3/8	SHEET NO 1-9	
AIRCRAFT: C105	FIN CHART RIB WEIGHT RIB 6.0	
PREPARED BY: J L Dixon	DATE: 16 FEB 55	
CHECKED BY:	DATE:	

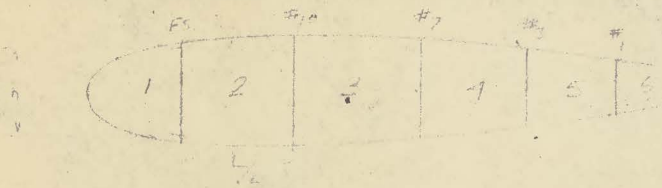


CELL	AREA	L	h	VOL VERT STRUTS			
1			4.95	[illegible] =	.80	[illegible]	[illegible]
2	14.9	5.40	5.40	[illegible]	.31	[illegible]	[illegible]
3	118.9	[illegible]	7.15	[illegible]	1.74	[illegible]	[illegible]
4	135.6	[illegible]	7.23	[illegible]	1.30	[illegible]	[illegible]
5	153.8	[illegible]	6.15	[illegible]	1.30	[illegible]	.265
6	58.5	19.0	3.44	[illegible]	.44		
7							
AREA	481.2	135.6					
VOL	39.00	11.30			7.55		

TOTAL VOL. 57.85

WEIGHT = 57.85 × .1 = <u>5.79 LB</u> [illegible]

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. 7/0523/?
		SHEET NO. 1.10
AIRCRAFT: C105	FIN GRAFT RIB WEIGHT RIB 2-0	PREPARED BY: J L DIXON — DATE: 16 FEB 55 CHECKED BY: — DATE:



CELL	AREA	L	h	VOL VERT. SIDES
1	—			
			4.50	2x.081h .73
2	98.5	33.0		
			6.50	3x.081h = 1.58
3	124.8	36.0		
			6.78	3x.081h = 1.65
4	147.9	43.2		
			5.74	3x.081h = 1.40
5	54.6	19.0		
			5.04	1x.081h = .41
6	—			
TOTAL.	425.8	132.2		
VOL.	34.50	10.70		5.77

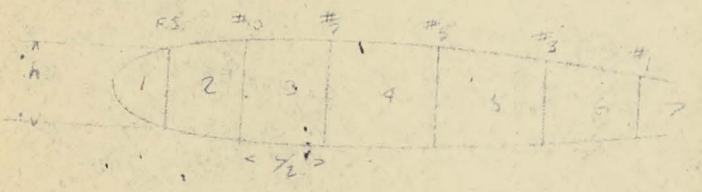
TOTAL VOL = 50.97

∴ WEIGHT = 50.97 × .1 = <u>5.10 lbs</u> + .81 = 5.9[illegible]

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	7/0583/8
SHEET NO.	1·11

AIRCRAFT:		PREPARED BY	DATE
C105	FIN CRAFT RIB WEIGHT RIB 48·0	J. L. DIXON	11 FEB 55
		CHECKED BY	DATE



CELL	AREA	L	h	VOL VERT STRUTS
1	—			
2	63·5	24·0	4·30	2×·072 h = ·62
3	117·7	36·0	5·95	3×·072 h = 1·29
4	77·7	23·2	6·55	3×·072 h = 1·41
5	61·1	20·0	6·30	3×·072 h = 1·36
6	52·3	19·0	5·70	3×·072 h = 1·23
7			4·97	1×·072 h = ·36
TOTAL AREA	372·3	122·2		
VOL.	26·81	8·80		6·27

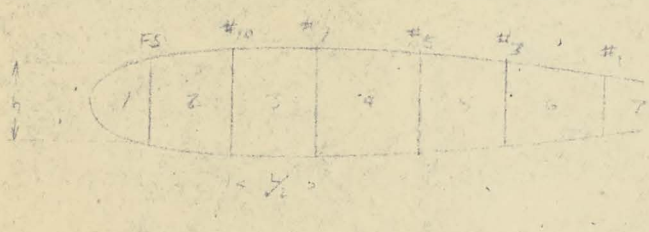
TOTAL VOL = 41·88

WEIGHT = 41·88 × ·1 = 4·19 LB.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 71/0583/8
SHEET NO. 3-12

AIRCRAFT:		PREPARED BY	DATE
C105	FIN CP AFT RIB WEIGHT RIB 670	J. L. DIXON	16 FEB 55
		CHECKED BY	DATE



CELL	AREA	L	h	VOL PER STRUT
1	—			
			3·75	2×·072 h = ·54
2	26·0	11·80		
			4·79	3×·072 h = 1·04
3	101·3	36·00		
			5·92	3×·072 h = 1·28
4	69·7	23·2		
			5·74	3×·072 h = 1·24
5	56·4	20·0		
			5·21	3×·072 h = 1·13
6	47·8	19·0		
			4·52	1×·072 h = ·33
7				
TOTAL AREA	301·2	110·0		
VOL	×·072 21·68	×·072 7·92		5·56

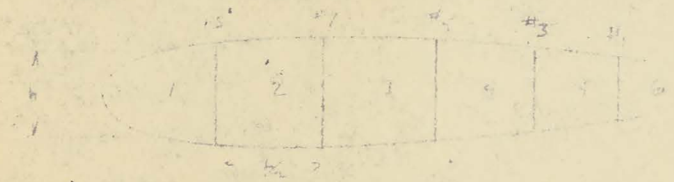
TOTAL VOL = 35·16

WEIGHT = 35·16 × ·1 = 3·52 LB

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	7/0183/6
SHEET No.	1-13

AIRCRAFT:		PREPARED BY	DATE
C-105	FIN CRAFT RIB WEIGHT RIB 92.2	J. L. DIXON	16 FEB 55
		CHECKED BY	DATE



CELL	AREA	L	h	VOL. VERT STRUTS			
1			3.45	3 × .072 × h =	.50	144 × [illegible]	[illegible]
2	83.8	34.00	5.18	3 × .072 × h =	1.12	144 × [illegible]	[illegible]
3	63.2	23.2	5.22	3 × .072 × h =	1.13	144 × [illegible]	[illegible]
4	50.3	22.0	4.80	3 × .072 × h =	1.04	144 × [illegible]	[illegible]
5	43.6	19.0	4.10	1 × .072 × h =	.89		3.47
6							
TOTAL AREA	240.9	98.2					
	× .072	× .072					
VOL.	17.36	7.07			4.68		

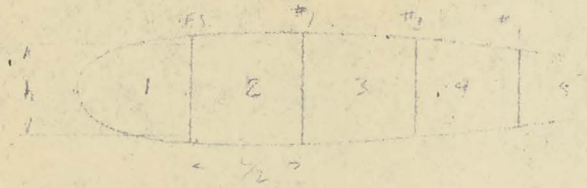
TOTAL VOL = 29.11

WEIGHT 29.11 × .1 = 2.91 lb + .35 = 3.26 lb

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO 7/0583/8	
C105	FIN C.P. AFT RIB WEIGHT. RIB 112.2	SHEET NO 1-14	
		PREPARED BY	DATE
		J. L. DIXON	16 FEB 55
		CHECKED BY	DATE



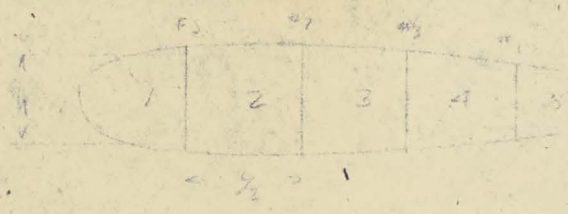
CELL	AREA	L	h	VOL VERT STRIPS	
1					
			3.12	2 × .069 × h =	.40
2	49.6	24.40			
			4.55	3 × .069 × h =	.86
3	103.4	43.2			
			4.43	3 × .064 × h =	.85
4	39.3	19.00			
			3.77	1 × .064 × h =	.24
5					
TOTAL	192.3	86.6			
VOL	12.31	5.55			2.35

128 × 3.34 = [illegible]
128 × 4.62 = [illegible]
128 × 4.65 = [illegible]
128 × 4.87 = [illegible]

TOTAL VOL = 20.21

WEIGHT = 20.21 × .1 = 2.02 LB + .23 = 2.25

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT No. 7/0589/8 SHEET No. 1-15	
		PREPARED BY	DATE
AIRCRAFT: C105	FIN [illegible] RIB WEIGHT. RIB 137.0	J. L. Dixon	16 [illegible]
		CHECKED BY	DATE



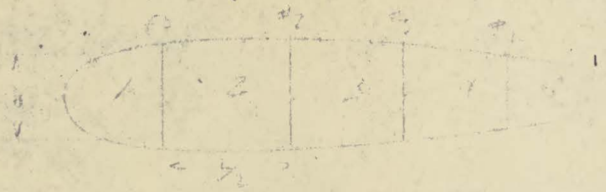
CELL	AREA	L	h	VOL VERT. STRUT	
1					
			2.82	2 × .044	.36
2	21.6	12.8			
			3.66	3 × .044	.70
3	89.3	43.2			
			4.00	3 × .044	.77
4	36.3	19.0			
			3.35	1 × .044	.21
5					
TOTAL	147.2	75.0			
VOL	9.42	4.80			2.04

TOTAL VOL = 16.26

WEIGHT = 16.26 × .1 = 1.63 LB + .15 = 1.78

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C 105	TIP CR AFT RIB WEIGHT RIB 14550	REPORT NO. 7/0588/8	SHEET NO. 1-11
		PREPARED BY: S. L. DIXON	DATE: 18 FEB 55
		CHECKED BY:	DATE:



CELL	AREA	L	h	VOL OF VERT STRUTS	
1			2.53	2× ·064 h =	·32
2	5.0	3.6	2.90	1× ·064 h =	·54
3	76.5	43.2	3.58	3× ·064 h	·69
4	32.6	19.0	3.01	1× ·064 h =	·19
5					
TOTAL AREA	114.1 × ·064	65.8 × ·064			
VOL.	7.30	4.21			1.74

TOTAL VOL = 13.25

WEIGHT = 13.25 × ·1 = 1.33 LB + 13 = 1.46

·197
·607
·591
·478
·398
·28
·274
·178
·096

TOTAL = 4.98

3.07

PRELIMINARY DETERMINATION OF SPAR GAUGES, AND NUMBER OF STIFFENERS

A. V. ROE
M…
TECH…

AIRCRAFT -
WEIGHT -
C. G. POSITIO…

C105 FIN CP AFT REAR SPAR (#1)

SPAR GAUGE - ·125

FOLLOWING CALS. HAVE BEEN MADE USING INTERACTION CURVE FROM TN 2536 (ASSUMING NO TRANSVERSE COMPRESSIVE STRESS)

1 2 3 4 5 6 7 8 9

STA 0 6 24 42 67 97·2 118·2 137 155·5

CELL #	1 σ MAX BENDING STRESS	2 τ MAX SHEAR STRESS	3 b	4 b^2	5 σ_{cr} $\frac{21·65 \times 10^7}{b^2}$ $\times 10^7$	6 τ_{cr} $\frac{4·84 \times 10^7}{b^2}$ $\times 10^7$	7 R_B ①/⑤ 10^3	8 R_S ②/⑥	9 SHEAR STRESS SUB. R ① lb/[illegible]	10 ·00651 t ·051	11 ·0005[illegible] t ·05[illegible]
1	66,000	2500/t	5·54	30·69	·705 t^2	·1568 t^2	9·36 t^{-2}	·1586 t^{-3}	20,000		
2	57,500	3500/t	5·42	29·37	·737 t^2	·1648 t^2	7·80 t^{-2}	·2125 t^{-3}			
3	36,000	2300/t	5·05	25·50	·849 t^2	·1898 t^2	4·24 t^{-2}	·1212 t^{-3}			
4	27,700	1940/t	4·80	23·04	·941 t^2	·2100 t^2	2·9[illegible] t^{-2}	·639 t^{-3}	10,7[illegible]0	·449	·835
5	23,600	1110/t	4·35	18·92	1·145 t^2	·2548 t^2	2·062 t^{-2}	·434 t^{-3}	8,880	·314	·816
6	19,600	990/t	3·93	15·44	1·402 t^2	·3135 t^2	1·399 t^{-2}	·316 t^{-3}	7,920		
7	15,700	770/t	3·63	13·18	1·643 t^2	·3670 t^2	·954 t^{-2}	·2090 t^{-3}	6,160		
8	9,500	1500/t	3·23	10·43	2·076 t^2	·4630 t^2	·458 t^{-2}	·324 t^{-3}	12,000		
9	3,600	70/t	2·90	8·41	2·574 t^2	·5750 t^2	·140 t^{-2}	·0122 t^{-3}	560		
	a/b	k_s	a	a^2		k_s/a^2					
1	1·084	7·5	6·0	36·0	·601 t^2	·2083	10·99 t^{-2}	1·200			
2	1·108	7·4	6·0	36·0	·601 t^2	·2058	9·56 t^{-2}	1·701 t^{-3}			

FORM 1543

C105 FIN CRAFT #3 SPAR

SPAR GAUGE ·102

	1	2	3	4	5	6	7	8	9
CELL #	σ MAX BENDING STRESS	τ MAX SHEAR STRESS	b	b^2	σ_{cr} $\frac{21.65 \times 10^7}{b^2}$ $\times 10^7$	τ_{cr} $\frac{4.81 \times 10^7}{b^2}$	R_B	R_Z	SHORT STR… SUB t … lb
1	50,500	$\frac{2500}{t}$	6·45	41·60	·520 t^2	·1163 t^2	$10^{-2}\times$ ·971 t^{-2}	$10^{-3}\times$ 2150 t^{-3}	24,…
2	43,700	$\frac{2500}{t}$	6·15	37·82	·572 t^2	·1281 t^2	·764 t^{-2}	1·952 t^{-3}	24,…
3	38,700	$\frac{1680}{t}$	5·75	33·06	·655 t^2	·1465 t^2	·560 t^{-2}	1·145 t^{-3}	16,4…
4	32,300	$\frac{1420}{t}$	5·52	30·47	·711 t^2	·1590 t^2	·454 t^{-2}	·892 t^{-3}	12,1…
5	28,000	$\frac{1020}{t}$	5·05	25·50	·849 t^2	·1900 t^2	·330 t^{-2}	·537 t^{-3}	10,0…
6	23,000	$\frac{820}{t}$	4·65	21·62	1·001 t^2	·2238 t^2	·229 t^{-2}	·366 t^{-3}	8,0…
7	18,650	$\frac{700}{t}$	4·30	18·49	1·171 t^2	·2620 t^2	·159 t^{-2}	·267 t^{-3}	6,…
8	11,000	$\frac{1310}{t}$	3·88	15·05	1·440 t^2	·3220 t^2	·763 t^{-2}	·407 t^{-3}	12,8…
9	4,200	$\frac{410}{t}$	3·47	12·04	1·797 t^2	·4020 t^2	·234 t^{-2}	·0025	
	a/b	K_τ				$\frac{K_\tau \times 10^7}{a^2}$			
1	1·29	6·9	5·00	25·0	·865	·2760	10^{-3} 5·83 t^{-2}	·905 t^{-3}	
2	1·23	7·0	5·00	25·0	·865	·2800	5·05 t^{-2}	·882 t^{-3}	
3	1·15	7·25	5·00	25·0	·865	·2900	4·24 t^{-2}	·579 t^{-3}	
4									

FORM 1543

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

TECHNICAL DEPT. (AIRFRAME)

REPORT NO. - 7/0X 23/8

SHEET - 2-4

DATE - 17 [illegible]

AIRCRAFT - C105

WEIGHT -

C. G. POSITION -

PREPARED BY - [illegible]

9	10	11	12	13	14	15	16	17	18	19
SHEAR STRESS [illegible] lb/in²	[illegible]	[illegible] t = .081	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	GAUGE	SAFETY FACTOR
[illegible]					.924	.167			.102	.04
17,[illegible]						.216	.663	.111	.156	
13,140							.647	.738	.125	
11,[illegible]0					.810	1.063	.640	.555	.125	
12,150					.641	.984	.440	[illegible]	.125	
10,[illegible]			.577	.335	.460	.644			.102	
11,570	.433	.117	.352	.824					.091	
11,150	.770	.875							.081	
9,[illegible]									.072	
62[illegible]										

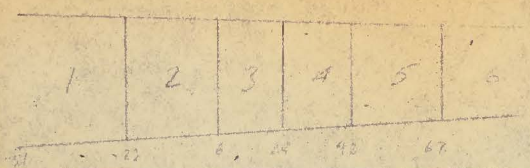
CELL #2 FACTOR OF SAFETY = $\frac{.926}{.875} - 1 = .06$

9	10	11	12	13	14	15	16	17	18	19
					.571	.875			.102	
					.671	.640			.102	
					.639	.521			.102	

A. V. ROE CAN[ADA]
MALTON, O[NTARIO]
TECHNICAL DEP[ARTMENT]

AIRCRAFT - -
WEIGHT - -
C. G. POSITION - -

C105 FIN CP AFT #10 SPAR
SPAR GAUGE - .081



CELL #	1 σ MAX BENDING STRESS	2 τ MAX SHEAR STRESS	3 b	4 b^2	5 σ_{cr} $\frac{.2165 \times 10^7}{b^2}$	6 τ_{cr} $\frac{4.14 \times 10^7}{a^2}$	7 R_B ①/⑤	8 R_τ ②/⑥	9 SHEAR STRESS SUB. ② W/O t	10 .00656 ⑦ t = .081	11 .00537 ⑧ t = .081	12 .00778 ⑤ t = .091
1	33,[illegible]	1080/t	8.50	72.25	$2996 t^2$	$.0612 t^2$	$11.20 t^2$	$1.7640 t^3$	7,6[illegible]			
2	35,000	1540/t	7.90	62.41	$.3466 t^2$	$.0715 t^2$	$.010 t^2$	$1.2200 t^3$	4,5[illegible]			
3	41,000	780/t	7.00	49.00	$.4415 t^2$	$.0989 t^2$	$9.28 t^2$	$.7890 t^3$	4,[illegible]			
4	37,800	620/t	6.45	41.60	$.5200 t^2$	$.1163 t^2$	$7.27 t^2$	$.5330 t^3$	7,2[illegible]0	.79 1.1	.79 .78 1.004	
5	33,800	560/t	5.77	33.29	$.6500 t^2$	$.1455 t^2$	$5.20 t^2$	$.3850 t^3$	6,[illegible]0	.792	.725	.827
6	25,000	9[illegible]/t	4.67	21.62	1.001	.2290	24.9 t	$.4150 t^3$	11,450	.381	.78[illegible]	
1K.5X	a/b	k_τ	a	a^2		$\frac{k_\tau \times 10^7}{a^2}$						
1	1.70	6.33	5.00	25.0	$.885 t^2$	.2532	$3.87 t$	$.426 t^3$		.490	.802	
2	1.76	6.25	4.50	20.25	$1.069 t^2$	.3090	$3.276 t^2$	$.433 t^3$		.500	.814	
3	1.40	6.70	5.00	25.0	$.885 t^2$	.2680	$4.74 t^2$	$.291 t^3$		.721	.548	
4	1.08	7.50	6.00	36.0	$.601 t^2$	.2081	$5.57 t^2$	$.2835 t^3$		.849	.533	
5	1.04	7.70	6.00	36.0	$.601 t^2$	.2140	$5.62 t^2$	$.2610 t^3$		.856	.493	
							SAFETY	FACTOR		CELL # 3	=	.982/.922
							"	"		CELL # 4	=	.980/.890

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. 7/[illegible] SHEET NO. 2-9	
AIRCRAFT: C105	EN GP AFT. I OF WEB STIFFENERS SPAR #7	PREPARED BY S. L. DIXON	DATE 18 FEB [illegible]
		CHECKED BY	DATE

SPAR #7

$d = 6.00 \quad b = .102$

CELL #2

$I = \frac{2.20 \times 6}{.102} \left(\frac{1170 \times 62.72}{38 \times 10^7} \right)^{\frac{4}{3}} = 134.9 \left(3.870 \times 10^{-7} \right)^{\frac{4}{3}}$

$= .00316 \text{ in}^4$

CELL #3

$I = 134.9 \left(\frac{1340 \times 42.3}{3 \times 10^7} \right)^{\frac{4}{3}} = 134.9 \left(2120 \times 10^{-7} \right)^{\frac{4}{3}}$

$= .00171 \text{ in}^4$

CELL #4

$I = 134.9 \left(\frac{[illegible] \times 46.10}{3 \times 10^7} \right)^{\frac{4}{3}} = 134.9 \left(1554 \times 10^{-7} \right)^{\frac{4}{3}}$

$= .00116 \text{ in}^4$

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/0583/8
SHEET NO. 2-15

AIRCRAFT: C105

FIN
ESTIMATE OF SPAR WEB WEIGHT
SPAR # 7

PREPARED BY	DATE
J. L. Dixon	18 FEB 55
CHECKED BY	DATE

7 STIFFENERS SPACED 2.0 UP TO STATION 24.0

CELL	LENGTH	H	ΔH	AREA L×ΔH
		7.7		
1	10		7.6	76.0
		7.5		
2	29		7.15	207.5
		6.8		
3	18		6.6	119.0
		6.4		
4	18		6.2	111.6
		6.0		
5	25		5.7	142.6
		5.4		
6	25.2		5.0	126.0
		4.6		
7	20		4.3	86.0
		4.0		
8	24.8		3.55	88.0
		3.1		
9	18.5		2.7	50.0
		2.3		
10	9.5		2.25	21.4
		1.8		
			AREA	1028.1

AV HT OF STIFFENERS
$= \frac{7.7+6.4}{2} = 7.05$

AREA = .0994 sq in

TOTAL VOL
$= 7 \times .0994 \times 7.05$
$= 4.90$ cu in

TOTAL VOL = 1028.1 × .102 + 4.90 = 109.8 cu in

10.49 + .49

Weight = 109.8 × .1 = 10.98 LB

AVRO AIRCRAFT LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT

REPORT NO. 7/0583/8.
SHEET NO. SECTION 3, SHT. 0

AIRCRAFT:		PREPARED BY	DATE
C. 105.	FIN.		
		CHECKED BY	DATE

PRELIMINARY DETERMINATION OF ATTACHMENTS, I.E

① SKIN TO SPARS.

② " " RIBS.

③ WEBS TO CAPS.

④ ANGLES TO RIBS & TO SPARS.

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. 7/0183/8 SHEET NO. 3-1	
		PREPARED BY	DATE
AIRCRAFT; C105	FIN STRENGTH OF RIVETED JOINTS SKIN TO SPARS.	J. L. DIXON	4 MARCH '55
		CHECKED BY	DATE

FRONT SPAR (FWD. SIDE)

1 RIB	2 END LOAD LB/IN	3 SHEAR FLOW	4 RESULTANT SHEAR $\sqrt{2^2+3^2}$	5 SKIN t	6 BEARING STRENGTH 3/16 HOLE	7 ULT BEARING STRENGTH ×1.37	8 SHEAR 3/16 FOR A-17S-T3 DIMPLED RIVETS	9 M. OF S.
6	17							
		160	162	·051	974	1,333	1036	5·39
29	24							
		151	153	↓	↓	↓	↓	5·76
42	16							
		166	168					5·16
67	27							
		144	146					6·09
92	23							
		126	128					7·10
112	21							
		90	96					9·79
137	33							
		228	229					3·52
155	69							
		14	70					13·80
TOP								

SPAR #1A (FWD SIDE)

1 RIB	2 END LOAD LB/IN	3 SHEAR FLOW	4 RESULTANT SHEAR $\sqrt{2^2+3^2}$	5 SKIN t	6 BEARING STRENGTH 1/4 HOLE	7 ULT BEARING STRENGTH	8 SHEAR OF 1/4 A17S-T3 SOLID C'SK RIVETS	9 M. OF S. USING (8)
-68	163							
		763	779	·099	2290	3140	1200	·54
-23	33							
		146	150	·093	2390	3270	1232	7·21
6	31							
		907	908	·086	2210	3020	1179	·30
24								

1/4 A17S-T3 SOLID CSK RIVETS

SPAR #1D (FWD. SIDE)

1 RIB	2 END LOAD LB/IN	3 SHEAR FLOW LB/IN	4 RESULTANT SHEAR $\sqrt{2^2+3^2}$	5 SKIN t	6 BEARING STRENGTH 1/4 HOLE	7 ULT BEARING STRENGTH	8 SHEAR FOR 1/4 A17S-T3 SOLID CSK RIVETS	9 M OF S USING (8)
-39	98							
		961	984	·109	2800	3830	1328	·35
-23	214							
		907	98.1	·099	2542	3480	1268	·29
6	372							
		890	964	·093	2390	3270	1232	·28
24	109							
		740	749	[illegible]	2210	3025	1179	·57
42	110							
		640	650	·077	1980	2710	1094	·68
67	77							
		339	348	·070	1800	2460	1030	1·96
92	3							

1/4 A17S-T3 SOLID CSK RIVETS

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/0583/8	SHEET NO. 3-4		
AIRCRAFT: C105	FIN — STRENGTH OF RIVETED JOINTS — SKIN TO SPARS	PREPARED BY: S. L. DIXON	DATE: 4 MARCH '55
		CHECKED BY:	DATE:

SPAR #3 (AFT SIDE) PITCH 1" SPAR t = SKIN × ·08 (FOR ... TO 10 ONLY)

NOTE RESULTANT SHEAR COMPUTED WITH SHEAR IN PANEL & LARGEST NEIGHBOURING END LOAD SHEAR

1	2	3	4	5	6	7	8	9	10	11	12
RIB	RIBWISE B.M.	DEPTH	[illegible]	END LOAD LB/IN	SHEAR FLOW #/IN	RESULTANT SHEAR $\sqrt{[illegible]}$	SKIN t	BEARING STRENGTH 3/16 HOLE	ULT BEARING STRENGTH ×1.37	SHEAR FOR 3/16 AN 509 STL SCREWS	M. of S. (11)
23	—										
6	60,000	6·38	23·5	400	1200	1265	·181	2765	3790	2120	·67
24	43,100	5·92	18·0	406	1321	1371	·175	2675	3660	2120	·55
42	1,000	5·70	21·5	8	1248	1312	·168	2568	3520	2120	·62
67	37,300	5·22	25·1	286	1120	1154	·160	2446	3360	2120	·83
92	24,500	4·80	22·6	226	945	988	·150	2293	3140	2120	1·14
112	36,400	4·43	22·4	367	826	903	·143	2185	2990	2120	1·35
137	113,500	4·00	21·6	1198	588	1336	·134	2048	2805	2120	·59
155	23,700	3·58	25·8	904	1136	1651	·129	1957	2680	2120	28
TOP					74	908	·120	1834	2514	2120	1·34

3/16 AN 509 SCREWS

SPAR #7 ([illegible])

3/16 30-BOLT

1	2	3	4	5	6	7	8	9	10	11	12
-23	48,700	8·20	23·0	205							
6·0	17,000	7·40	23·5	98	380	430	·174	2658	3640	2120	3·93
24·0	65,000	6·94	18·0	520	1527	1680	·168	2565	3510		·26
42·0	15,800	6·55	21·5	112	1394	1485	·161	2460	3370		·42
67·0	23,020	5·82	25·1	222	1473	1490	·154	2320	3180		·42
92·2	10,000	5·19	22·6	85	1261	1220	·143	2182	2990		·74
112·2	10,960	4·58	22·4	107	949	974	·136	2078	2844		1·18
137·0	15,000	3·67	21·6	182	354	630	·127	1940	2656		2·12
155	9,850	2·82	25·8	125	1054	1110	·120	1830	2508		·91
TOP					90	154	·110	1680	2300	↓	12·77

30-BOLTS

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	7/0583/8
SHEET No.	3-5
PREPARED BY	DATE
S. L. DIXON	21 FEB 55
CHECKED BY	DATE

AIRCRAFT: C105

FIN RIBS.
SHEAR IN RIVETS
SKIN TO RIBS

STA 155.5. t=.064 VALUES OF SHEAR FLOW FROM REP. 7/0583/3 B
(MAX VALUES TAKEN)
PITCH = 1"

1	2	3	4	5	6	7	8	9
SPAR	DIFF IN SHEAR FLOW X P	SKIN t	SHEAR FOR 1/4 A17S-T3 SOLID CSK RIVET		BEARING STRENGTH	FACTOR	6×7	SAFETY FACTOR 8/2 - 1
#1	1062	.128	1400		1640	1.37	2245	.32
#3	1009	.120	1368		1640	1.37	2245	.36
#7	647	.114	1339		1640	1.37	2245	1.07
FS								

1/4 A17S-T3 SOLID CSK

STA 137.0 .064

1	2	3	4	5	6	7	8	9
SPAR	DIFF IN SHEAR FLOW X P	SKIN t	SHEAR FOR 3/16 A17S-T3 SOLID CSK RIVET		BEARING STRENGTH 3/16	FACTOR	6×7	SAFETY FACTOR 8/2 - 1
#1	548	.134	853		1220	1.37	1670	.56
#3	440	.127	853		1220	1.37	1670	.94
#7	319	.121	847		1220	1.37	1670	1.68
F.S.								

3/16 A17S-T3 SOLID CSK

STA 112.5 .064

1	2	3	4	5	6	7	8	9
SPAR			A17S-T3 3/16 SOLID					
#1	238	.143	853		1220	1.37	1670	2.55
#3	295	.136	853		1220	1.37	1670	1.89
#7	223	.120	853		1220	1.37	1670	2.92
FS								

3/16 A17S-T3 SOLID CSK

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. 7/0583/8 SHEET NO. 3-8	
AIRCRAFT: C105	FIN STRENGTH OF RIVETED JOINTS WEB TO SPAR CONNECTIONS	PREPARED BY J. L. DIXON	DATE 3 MARCH 55
		CHECKED BY	DATE

SPAR #1 SHT. t = ·125

ULT. BEARING. STRENGTH FOR 1/4 HOLE = 3,210 × 1·14 = 3560 lb. & FOR 3/16 = 2,390 × 1·37 = 3270 lb

1	2	3	4	5	6	7	8	9	10	11
RIB	MAX * SHEAR FLOW ULT lb/in	PITCH IN.	SHEAR FORCE ON RIVET LB	SHEAR FOR STEEL 1/4 HUCK LOCKBOLT	SHEAR FOR 75S-T6 1/4 HUCK LOCKBOLT	SHEAR FOR 1/4 A17S-T3 SOLID CSK	SHEAR FOR HI-SHEAR 1/4 AN-4 (MAX)	MARGIN OF SAFETY USING (5)	MARGIN OF SAFETY USING (7)	MARGIN OF SAFETY USING (8)
0										
	2500	1·0	2500	4,650	2,280	1,391	3,680	·42 †		·42 †
6·0										
	3500	1·0	3500	4,650	↓	↓	↓	·02 †		·02 †
24·0										
	2300	1·0	2300	4,650				·55 †		·55 †
42·0										
	1350	1·0	1350	4,650					·03	
67·0										
	1110	1·0	1110	4,650					·25	
92·2										
	990	1·0	990	4,650					·40	
112·2										
	770	1·0	770	4,650					·81	
137·0										
	1500	1·0	1500	4650				1·37 †	—	1·37 †
155										
	70	1·0	70	4650	↓	↓	↓		12·28	
TOP										

* REF REF # 7/0583/2 & REF # 7/0583/3

† ALTERNATIVE CHOICE

SPAR #3 SHEET = ·102

ULT. BEARING STRENGTH FOR 1/4 HOLE = 2,620 × 1·14 = 2980 lb & FOR 3/16 = 1,910 × 1·37 = 2620 lb

1	2	3	4	5	6	7	8	9	10	11
-23·0										
	2,500	1·0	2,500	4,650	2280	1287	3,680	·19 †		·19 †
6·0										
	2,500	1·0	2,500	↓	↓	↓	↓	·19 †		·19 †
24·0										
	1,680	1·0	1,680					·77 †		·77 †
42·0										
	1,420	1·0	1,420					1·10 †		1·10 †
67·0										
	1,020	1·0	1,020						·26	
92·2										
	830	1·0	830						·55	
112·2										
	700	1·0	700						·84	
137·0										
	1,300	1·0	1,300					1·29 †	—	1·29
155·0										
	20	1·0	20	↓	↓	↓	↓		62·20	
TOP										

SPAR #5 SHEET t = ·102

1	2	3	4	5	6	7 (100° CSK HEAD)	8	9	10	11
42·0										
	685	1·0	685	4,650	2280	1,550	3680		1·28	
67·0										
	690	1·0	690	4,650	2280	1,550	3680		1·42	
92·2										

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. 7/0583/8 SHEET NO. 3-9	
AIRCRAFT: C105	FIN STRENGTH OF RIVETED JOINTS WEB TO SPAR CONNECTIONS	PREPARED BY J L DIXON	DATE 3 MARCH '55
		CHECKED BY	DATE

SPAR #7 SHT t = ·102

ULT BEARING STRENGTH FOR 1/4 HOLE = 2,620 × 1·14 = 2980 lb ; FOR 3/16 = 1,910 × 1·37 = 2620 lb

1	2	3	4	5	6	7	8	9	10	11	12
RIB	MAX SHEAR FLOW ULT lb/in	PITCH IN	SHEAR FORCE ON RIVET LBS	SHEAR FOR STEEL 1/4 HUCK LOCKBOLT	SHEAR FOR 75S-T6 1/4 HUCK LOCKBOLT	SHEAR FOR 1/4 A17S-T3 SOLID CSK	SHEAR FOR HI-SHEAR 1/4 AN-4 (MAX)	MARGIN OF SAFETY USING (5)	M OF S USING (6)	M OF S USING (7)	M OF S USING (8)
-23.0 – 6.0	1770	1	1770	4650	2,280	1,287	3,680	·68†	·23†		·68†
6.0 – 24.0	1340	1	1340	↓	↓	↓	↓	1·22†	·70†		1·22†
24.0 – 42.0	1140	1	1140							·13	
42.0 – 67.0	1240	1	1240							·04	
67.0 – 92.2	1020	1	1020							·26	
92.2 – 112.2	1180	1	1180							·09	
112.2 – 137.0	1140	1	1140							·13	
137.0 – 155	980	1	980							·31	
155 – TOR	70	1	70							·38	

† ALTERNATIVES

SPAR #10 SHEET t = ·081

ULT BEARING STRENGTH FOR 1/4 HOLE = 2,080 × 1·14 = 2,370 LB , FOR 3/16 = 1550 × 1·37 = 2,120 LB

1	2	3	4	5	6	7	8	9	10	11	12
RIB	MAX SHEAR FLOW ULT lb/in	PITCH IN	SHEAR FORCE ON RIVET LBS	SHEAR FOR STEEL 1/4 HUCK LOCKBOLT	SHEAR FOR 75S-T6 1/4 HUCK LOCKBOLT	SHEAR FOR 1/4 A17S-T3 SOLID CSK	SHEAR FOR 1/4 HI-SHEAR AN-4 (MAX)	MARGIN OF SAFETY USING (5)	M OF S USING (6)	M OF S USING (7)	M OF S USING (8)
-51 – -23	1080	1	1080	4,650	2280	1049	3680			·03	[illegible]
-23 – 6.0	1340	1	1340	↓	↓	↓	↓	·77†	·70†		·77†
6.0 – 24.0	780	1	780							·34	
24.0 – 42.0	620	1	620							·69	
42.0 – 67.0	550	1	550							·91	
67.0 – 92.2	930	1	930							·13	

AVRO AIRCRAFT LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT

AIRCRAFT: C. 105.	FIN.	REPORT NO. 7/0583/8. SHEET NO SECTION 4, SHT. 0
		PREPARED BY / DATE
		CHECKED BY / DATE

FRONT SPAR ANALYSIS.

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT NO. 7/0583/8 SHEET NO. 4-1	
AIRCRAFT: C-105	FRONT SPAR ANALYSIS	PREPARED BY: L. MATALON	DATE: 5-12-55
		CHECKED BY	DATE

INTRODUCTION

THE FIN FRONT SPAR RUNS AT AN ANGLE OF 32°13' FROM THE WING & FIN DATUM LINE WHILE THE OTHER FIN SPARS & STRINGERS RUN AT AN ANGLE OF 56°57'. THIS CAUSES ATTACHMENTS ALONG THE FIN FRONT SPAR OF THREE SPARS, SEVEN STRINGERS AND EIGHT RIBS.

THE DISCONTINUOUS STRINGERS AND SPAR CAPS ARE ATTACHED TO THE FRONT SPAR BY GUSSETS & SKIN, THE DISCONTINUOUS SPAR WEBS ARE ATTACHED DIRECTLY TO THE FRONT SPAR WEB AND THE RIBS ARE ATTACHED TO THE FRONT SPAR WEB BY BENT UP ANGLES.

IT IS ASSUMED THAT THE DISCONTINUOUS SPARS AND STRINGERS BECOME FULLY EFFECTIVE ALONG THE LENGTH OF THE GUSSET ATTACHMENT.

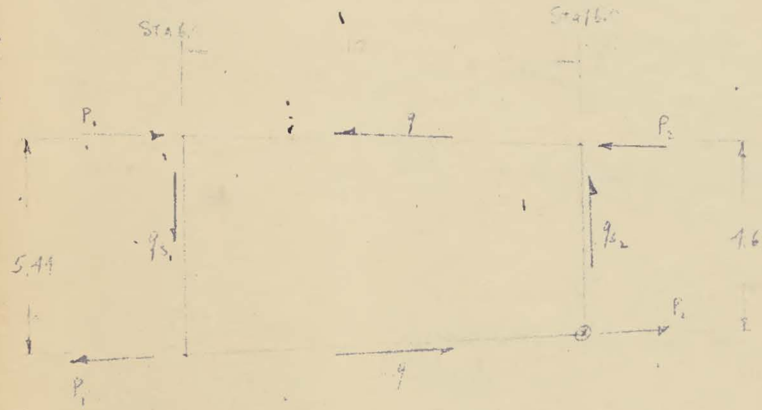
THE FRONT SPAR HAS A WEB SPLICE AT F/ STATION 184.0 AND A CAP SPLICE AT F/S STATION 170.5.

THIS REPORT INCLUDES THE ANALYSIS OF THE FRONT SPAR AND THE ATTACHMENTS ALONG ITS LENGTH.

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/[illegible] SHEET No. 4.4	
		PREPARED BY	DATE
AIRCRAFT: C-105	FRONT SPAR ANALYSIS	L. MATALON	4-19-55
		CHECKED BY	DATE

DETERMINATION OF LOADS

a) AT SPAR #14 (HINGE ℄ STA. 6.0 TO 16.0)



$\sigma_1 = 31000$ psi
$A_1 = 1.495$ in^2 } Ref. P_4

$P_1 = 31000(1.495) = 46400$ lb

$q_{s_1} = 464$ #/in
$q = 907 - 326 = 581$ #/in } Ref. P_4

$\Sigma M_o = 0$

$(46400 - 5610)(4.66)(.999) - P_2(4.66)(.999) - 464(5.44)(10) = 0$

$P_2 = 35170$ lb

$A_2 = 1.339$ in^2 (Ref. P_4)

$\sigma_2 = 26130$ psi (Compression [illegible] σ_1 of Ref. P_4 = 26[illegible])

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT NO. 7/0583/8 SHEET NO. 4·5	
		PREPARED BY	DATE
AIRCRAFT: C-105	FRONT SPAR ANALYSIS	L. MATALON	4-19-55
		CHECKED BY	DATE

DETERMINATION OF LOADS

a) AT SPAR #14 (CONT'D)

$\Sigma V = 0$

$$2P_1(.034) + q_{s_1}(5.44) - 2q(1\cdot X.039) - 2P_2(.039) = q_{s_2}(4.66)$$

$q_{s_2} = 632\ \#/IN$ (CHECKS WITH SHEAR FLOW OF REF. P_{4} = 632)

A_2 (TOTAL) = $1.339\ IN^2$

A_2' (SPAR CAP #14) = $.308\ IN^2$

∴ END LOAD TRANSFERRED TO SPAR CAP #14 FROM FRONT SPAR & SKIN

$$P_2' = \frac{P_2 A_2'}{A_2} = \frac{35170(.308)}{1.339} = 8100\ \#$$

SHEAR LOAD TRANSFERRED TO SPAR WEB #14 FROM FRONT SPAR WEB

$$V_2' = q_{s_2} h_2 = 632(4.66) = 2950\ \#$$

FORM 1919A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO	7/0533/8
SHEET NO	4-18
PREPARED BY	DATE
L. M[illegible]	4-29-58
CHECKED BY	DATE

AIRCRAFT	
C-105	FRONT SPAR ANALYSIS

CHECK TRANSFER OF LOAD TO SPAR #14

CHECK OF RIVET ATTACHMENTS (CONT'D.)

c) RIVETS 19-22:

3/16 HI-SHEAR-RIVETS

RIVET LOAD = 1070 #

RIVET ALLOWABLE = 1100 (1.364) = 1510 # ([illegible])

$$MS = \frac{1510}{1070} - 1 = .41$$

RNI 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FRONT SPAR ANALYSIS	REPORT NO. 71/STRESS/18	SHEET NO. 4-30
		PREPARED BY: L. MATALON	DATE: 5-3-55
		CHECKED BY:	DATE:

CHECK TRANSFER OF LOAD TO SPAR #10

DETERMINATION OF LOADS

b) AT FRONT SPAR (CONT'D)

$\Sigma M_0 = 0$

$$\left[12100 + 24850 + 195(15.0)\right]3.46 - P_4(3.46) - 102(3.68)(15.0)$$

$$\therefore P_4 = 38200\ \#$$

$$A_4 = 1.916 + .382 = 2.298$$

$$\sigma_4 = \frac{38200}{2.298} = 16600\ psi$$ (COMPARES WITH T_{UF} REF P_4 = 16539 psi)

$\Sigma V = 0$

$$2P_3(.0147) + q_{s3}(3.68) - 2q(1.5)(.0147) + 2P_2''(.0147) - 2P_4(.0147) + V_4'' = q_{s4}(3.46)$$

$$\therefore q_{s4} = 999\ \#/in$$

(COMPARES WITH SHEAR FLOW OF REF P_4 = 1116 #/in)

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT NO. 7/0533/8 SHEET NO. 4.36	
AIRCRAFT: C-105	FRONT SPAR ANALYSIS	PREPARED BY: L. MATALON	DATE: 5-4-55
		CHECKED BY:	DATE:

CHECK TRANSFER OF LOAD TO SPAR #10 (CONT'D)

CHECK OF SECTION B-B (SAME SECTION PROPERTIES AS SECTION A-A)

SECTION B-B WILL BE CHECKED FOR COLUMN ACTION, ASSUMING THE LOAD AT SECTION B-B AS AVERAGE OVER A LENGTH OF 4.7 INCHES.

$$M = 3200(2.7) = 8650 \text{ "\#}$$

DISTANCE OF THE CENTROID OF THE AREA ABOVE THE NEUTRAL AXIS FROM THE NEUTRAL AXIS.

$$\bar{y} = \frac{1.45(.081)(.725) + .131(.85) + .0484(.475)}{1.45(.081) + .131 + .0484} = .784$$

$$P_{COUPLE} = \frac{8650}{2(.784)} = 5500 \text{ \#}$$

$$f_{COL} = \frac{5500}{.296} = 18500 \text{ psi}$$

$$\rho_{yy} = \sqrt{\frac{.0332}{.5958}} = .2[illegible]$$

$$L/\rho = \frac{4.7}{.236} = 20.[illegible]$$

$$F_{cc} = 55000 \text{ psi} \quad (R[illegible])$$

$\therefore$ COLUMN ACTION IS NOT CRITICAL

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FRONT SPAR ANALYSIS	REPORT NO. 7/0583/18	SHEET NO. 4-38
		PREPARED BY: L. MATALON	DATE: 5-5-55
		CHECKED BY	DATE

CHECK TRANSFER OF LOAD TO SPAR #7 & FRONT SPAR

DETERMINATION OF LOADS

THE TOTAL END LOAD, AT THE INTERSECTION OF THE FRONT SPAR & SPAR #7 WITH THE TIP RIB, OF THE COMBINED SKIN & CAP COMBINATIONS OF THE FRONT SPAR & SPAR #7 IS EQUAL TO 18917 # (REF PG -).

THE TOTAL SHEAR PICKED UP AT THE TIP RIB IS EQUAL TO 768 # (REF - PG -)

END LOAD TRANSFERRED TO SPAR #7 & FRONT SPAR CAPS

THE END LOAD TRANSFERRED INTO THE CAP OF THE FRONT SPAR & SPAR #7 IS EQUAL TO THE TOTAL LOAD TIMES THE RATIO OF THE CAP AREAS TO THE TOTAL AREA.

$$A_{TOTAL} = 2.22 \text{ IN}^2$$

$$A_{CAPS} = .58 \text{ IN}^2$$

$$P = 18917\left(\frac{.58}{2.22}\right) = 5000\#$$

SINCE THE END LOAD TRANSFERRED TO SPAR CAP #7 & THE FRONT SPAR CAP IS SMALLER THAN THAT TRANSFERRED TO SPAR CAP #14 (5000# TO 8180# REF PG) AND THE STRUCTURE IS SIMILAR NO FURTHER ANALYSIS FOR THE TRANSFER OF END LOAD IS NECESSARY.

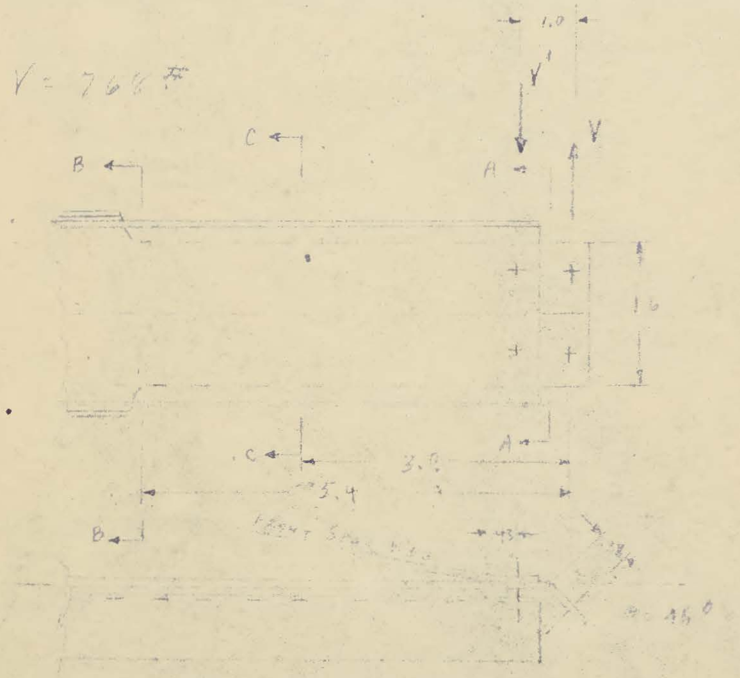
RM 1319A

CHECK TRANSFER OF LOAD TO SPAR #7 & FRONT SPAR

DETERMINATION OF LOADS (CONT'D)

SHEAR LOAD TRANSFERRED TO SPAR #7 & FRONT SPAR WEBS *

V = 768 #



* Change – The above structure is changed in so far as the cap of spar #7 is continuous up to the attachment to the cap of rib [illegible] making a stabilizing channel. The front spar cap however is discontinuous about 5.4" away from the front spar web [illegible] to spar #7, however since the shear in the front spar web is extremely small, no stabilizing of the web is necessary. Since the structure is obviously sound the calculations on pp. 4-40 to 4-45 will not be revised at this time.

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	7/0583/8
SHEET No.	A-41
PREPARED BY	DATE
L. MATALON	5-11-55
CHECKED BY	DATE

AIRCRAFT: C-105

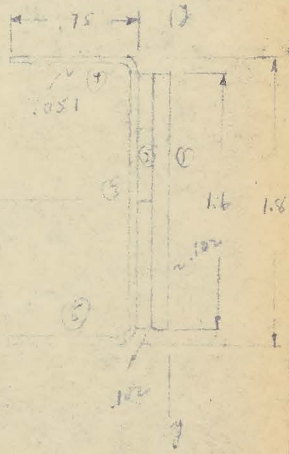
FRONT SPAR ANALYSIS

CHECK TRANSFER OF LOAD TO SPAR #7 & FRONT SPAR (CONT'D)

CHECK OF SECTION B-B

(c) FOR LATERAL INSTABILITY (REF "THEORY OF ELASTIC STABILITY" TIMOSHENKO P. 245)

$P = V - V' = 768 - 153 = 615^{\#}$



ITEM	A	x	Ax	Ax²	I_y
1	.1630	.0510	.00831	.000424	.00014
2	.1630	.1530	.02495	.003820	.00014
3	.0916	.2295	.02100	.004810	.00002
4	.0356	.6045	.02150	.013000	.00144
5	.0356	.6045	.02150	.013000	.00144
	.4888		.09726	.035054	.00318

$\bar{x} = \frac{.09726}{.4888} = .199$

$I_{yy} = .035054 + .00318 - .09726(.199) = .0188 \text{ IN}^4$

FORM 1319A

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/0583/8 SHEET No 4-42	
		PREPARED BY	DATE
AIRCRAFT: C-105	FRONT SPAR ANALYSIS	L. MATALON	5-11-55
		CHECKED BY	DATE

CHECK TRANSFER OF LOAD TO SPAR #7 & FRONT SPAR

CHECK OF SECTION B-B

a) FOR LATERAL INSTABILITY (CONT'D)

$$P_{CR} = \frac{4.013\sqrt{BC}}{l^2}$$

WHERE $B = I.E = .0188(10.3)10^6 = 193,006$

$$C = 4I\left(1 - .630\, t/h\right)G = 4(.0188)\left[1 - .630\left(\frac{.255}{1.6}\right)\right]3.9 \times 10^6$$

$$= 264000$$

$$l = 5.4$$

$$\therefore P_{CR} = \frac{4.013\sqrt{(193000)(264000)}}{(5.4)^2} = 2940\ \#$$

$$P = 615\ \#$$

MS = LARGE

b) FOR FLANGE BUCKLING

$$I_{xx} = \frac{.102(1.6)^3}{12} + \frac{2(.102)(.5)^3}{12} + 2(.102)(.8)(.4)^2 + \frac{.051(1.8)^3}{12} + 2(.7)(.051)(.87)^2$$

$$= .149\ in^4$$

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT NO. 7/0583/8 SHEET NO. 4:43	
		PREPARED BY	DATE
AIRCRAFT:	FRONT SPAR	L. MATALON	5-11-55
C-105	ANALYSIS	CHECKED BY	DATE

CHECK TRANSFER OF LOAD TO SPAR #7 & FRONT SPAR

CHECK OF SECTION B-B

b) FOR FLANGE BUCKLING (CONT'D)

$$M = 768(5.4) - 153(4.4) = 3480 \text{ "\#}$$

$$f_c = \frac{3480(.875)}{.149} = 20400 \text{ psi}$$

$$F_{CR} = 29000 \text{ psi}$$

$$MS = \frac{29000}{20400} - 1 = .42$$

.42

CHECK OF SECTION C-C

SECTION C-C WILL BE CHECKED FOR COLUMN ACTION, ASSUMING THE LOAD AT SECTION B-B AS AVERAGE OVER A LENGTH OF 5.4".

$$M = 768(3.0) - 153(2.0) = 2000 \text{ "\#}$$

DISTANCE OF THE CENTROID OF THE AREA ABOVE THE NEUTRAL AXIS FROM THE NEUTRAL AXIS.

$$\bar{y} = \frac{.0356(.875) + .0456(.45) + .163(.40)}{.244} = .477$$

$$P_{COUPLE} = \frac{2000}{2(.477)} = 2090 \text{ \#}$$

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/[illegible]	
		SHEET No. 4-47	
AIRCRAFT: C-105	FRONT SPAR ANALYSIS.	PREPARED BY: L. MATALON	DATE: 5-2-55
		CHECKED BY	DATE

CHECK OF FRONT SPAR ATTACHMENT TO WING DIAPHRAM

CHECK OF BOLT ATTACHMENTS

THE FRONT SPAR WEB ATTACHMENT TO THE WING DIAPHRAM IS ASSUMED TO TRANSFER THE WEB SHEAR ONLY. THE CAP LOAD IS ASSUMED TRANSFERRED TO THE SKIN AND THENCE TO THE WING AND FUSELAGE STRUCTURE THRU THE FINGER ATTACHMENTS.

THE ATTACHMENT PLATE IS ASSUMED PIN ENDED AT THE 1/4" LOCKBOLTS (TO BOLTS) # 13 TO 17. THE ECCENTRIC MOMENT M_{zz} IS RESISTED BY A COUPLE ON THE AN # 10 BOLTS # 1 TO 4 & 9 TO 12 PUTTING TENSION ON ONE SIDE. THE MOMENT M_{yy} IS ALSO RESISTED BY THE SAME BOLTS IN SHEAR.

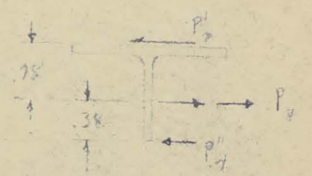
SHEAR LOAD = 4430 # (REF [illegible])

$M_{zz} = 4430(-.34)\tan 32°12' = -950$ "#

$M_{yy} = 4430(-4.7) = -20800$ "#

a) BOLTS 1-4

THE TENSION LOAD ON BOLTS # 1-4 IS RESISTED AT THE SKIN. THE ECCENTRIC MOMENT PUTS ADDITIONAL TENSION ON THE BOLTS.



$$P_x = P'_x + P''_x$$

$$= \frac{M_{zz}}{4.9(4)} + \frac{M_{zz}\,(.78)}{4.9(4)(.38)}$$

AVRO AIRCRAFT LIMITED **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. 7/0583 SHEET NO. 4-50	
AIRCRAFT:		PREPARED BY	DATE
C-105	FRONT SPAR ANALYSIS	L MATALON	5-2-55
		CHECKED BY	DATE

CHECK OF FRONT SPAR ATTACHMENT TO WING DIAPHRAGM.

CHECK OF SECTION A-A

$P_{SHEAR} = 4430^{\#}$ (REF P_{G})

$M_{33} = -950^{"\#}$ (REF P_{1})

$M_{xy} = 4430(1.0) = 4430^{"\#}$

$$f_b = \frac{4430(6)}{.125(5.7)^2} = 6500 \text{ psi}$$

$$f_{S_{MAX}} = \left(\frac{3}{2}\right)\frac{4430}{.125(5.7)} + \frac{3(950)}{5.7(.125)^2} = 41300 \text{ psi}$$

$F_S = 43000$ psi (REF)

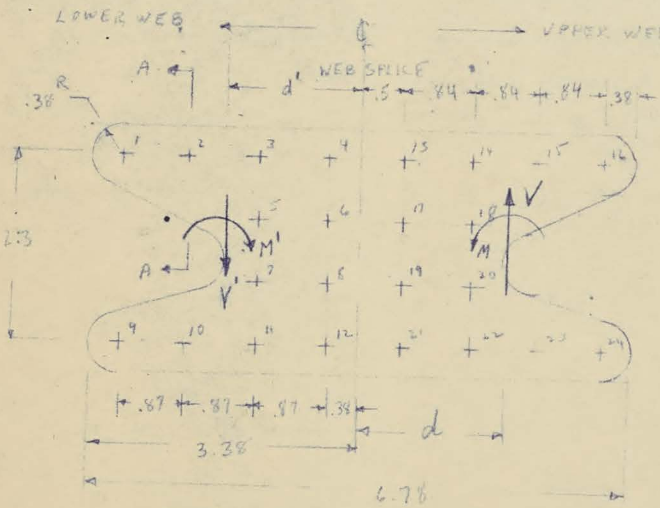
$$MS = \frac{43000}{41300} - 1 = .04$$

.04

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FRONT SPAR ANALYSIS	REPORT No. 7/0583/18	SHEET No. 4.54
		PREPARED BY: L. MATALON	DATE: 5-6-55
		CHECKED BY:	DATE:

CHECK OF WEB SPLICE (F/S STA 184 = HINGE ℄ STA 84.0)



3/16 AD RIVETS
.072 SPLICE PLATE
75 ST-6 ALCLAD

$V = q\,h = 101\,(3.7) = 374^{\#}$ (REF P.9)

$$d = \frac{4\,(.5) + 4\,(1.34) + 2\,(2.18) + 2\,(3.02)}{12} = 1.48''$$

$$d' = \frac{4\,(.38) + 4\,(1.25) + 2\,(2.12) + 2\,(3.00)}{12} = 1.40''$$

AIRCRAFT:		PREPARED BY	DATE
C-105	FRONT SPAR ANALYSIS	L. MATALON	5-6-55
		CHECKED BY	DATE

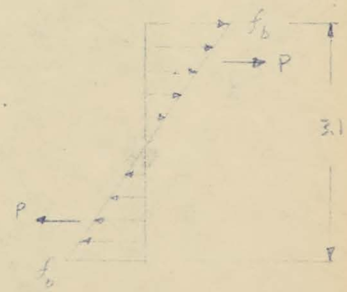
CHECK OF WEB SPLICE (CONT'D)

THE SHEAR & MOMENT IN THE UPPER WEB IS TRANSFERRED TO THE SPLICE PLATE BY RIVETS # 13 TO 19. IT IS ASSUMED THAT THE SHEAR IS EQUALLY DISTRIBUTED TO RIVETS # 13 TO 19 AND THE MOMENT PUT ON RIVETS # 13 TO 16 & 21 TO 24 AS A COUPLE. THE SHEAR & MOMENT IN THE SPLICE PLATE IS SIMILARLY TRANSFERRED TO THE LOWER WEB.

$V = 374^{\#}$ (REF P.)

$M_{FIN} = 1.14 \times 10^{6}$ "# } REF P_4

$I_{FIN} = 116 \text{ IN}^4$



BENDING DISTRIBUTION ON .064 WEB

$$\therefore f_b = \frac{1.14 \times 10^6 (1.55)}{116} = 15250 \text{ psi}$$

$$P = \frac{15250 (1.55)(.064)}{2} = 755^{\#}$$

$$M = (755)(3.1)\ ^2/_3 = 1560 \text{ "\#}$$

$$V' = V = 374^{\#}$$

$$M' = M + V(d+d') = 1560 + 374 (2.88) = 2640 \text{ "\#}$$

CHECK OF CAP SPLICE (CONT'D)

b) TRANSFER OF LOAD IN LEG OF F/S CAP TO SPLICE MEMBER

THERE ARE THREE 3/16 AD RIVETS IN DOUBLE SHEAR TO TRANSFER THE LOAD TO THE SPLICE MEMBER.

$$LOAD/RIVET = \frac{1440}{3} = 480 \ \#/RIVET$$

DOUBLE SHEAR ALLOWABLE = 1724 #/RIVET

BEARING ALLOWABLE = 125000(.1875)(.064) = 1500 #/RIVET

MS = LARGE

c) TRANSFER OF LOAD FROM SPLICE MEMBER TO CAP

THE ATTACHMENTS ARE THE SAME IN TRANSFERRING THE LOAD FROM THE SPLICE MEMBER TO THE F/S CAP AS IN TRANSFERRING THE LOAD FROM THE F/S CAP TO THE SPLICE MEMBER ∴

MS = LARGE

d) CHECK OF SPLICE MEMBER

THE SPLICE MEMBER CONSISTS OF TWO 75ST6 EXTRUDED ANGLES WHOSE COMBINED AREA IS .315 IN^2 AS COMPARED TO .282 IN^2 OF THE F/S CAP, ∴ IT IS OBVIOUS THAT THE SPLICE MEMBER IS NOT CRITICAL.

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FRONT SPAR ANALYSIS	REPORT NO. 7/0583/8	SHEET NO. 4-61
		PREPARED BY: L. MATALON	DATE: 5-9-55
		CHECKED BY:	DATE:

CHECK TRANSFER OF LOAD TO STRINGERS @ F/S INTERSECTION

LOAD TRANSFERRED TO STRINGERS

F/S STA REF	HINGE ℄ STA P_G	STRINGER #	σ P_G	CAP AREA	CAP LOAD
60.2	-36.1	16	23500	.128	3000
91.4	- 5.8	15	23000	.128	2940
137.2	38.6	13	24600	.128	3150
156.0	57.0	12	22000	.128	2820
166.7	67.3	11	20700	.125	2580
216.3	115.2	9	12700	.150	1900
241.3	131.5	8	7400	.150	1110

AS SEEN FROM ABOVE TABULATION STRINGER #13 HAS THE HIGHEST LOAD TRANSFERRED INTO THE CAP. ASSUME THE ENTIRE LOAD IS TRANSFERRED INTO THE CAP THRU THE GUSSET.

ALL OF THE ABOVE STRINGERS HAVE SIMILAR GUSSET ATTACHMENTS TO THE FRONT SPAR EXCEPT STRINGER # 11 WHICH IS TIED TO RIB # 5. THE LOAD IS TRANFERRED TO RIB #11 THRU THE SKIN DIRECTLY.

FORM 1319A

AVRO AIRCRAFT LIMITED **TECHNICAL DEPARTMENT (Aircraft)**		REPORT No. 7/0583/18 SHEET No. 4-65	
AIRCRAFT:		PREPARED BY	DATE
C-105	FRONT SPAR ANALYSIS	L. MATALON	5-9-55
		CHECKED BY	DATE

CHECK TRANSFER OF LOAD TO STRINGERS @ F/S INTERSECTION

CHECK OF GUSSET @ STRINGER #13 (CONT'D)

CHECK SHEAR TEAR OUT OF GUSSET @ BOLT #7

$P_{total} = 880^{\#}$ (REF P.)

SHEAR AREA $= 2(.38 - .094).064 = .0366$

$f_s = \dfrac{880}{.0366} = 24000$ psi

$F_s = 44000$ psi (REF)

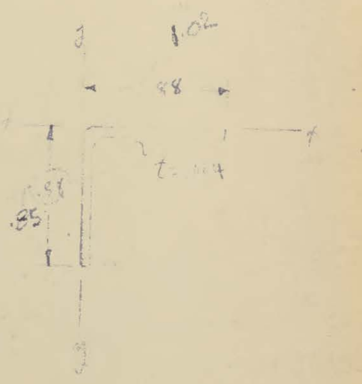
$MS = \dfrac{44000}{24000} - 1 = .83$

CHECK OF SECTION A-A

$\bar{y} = \bar{x} = \dfrac{.88(.064)(.032) + .816(.064)(.472)}{.88(.064) + .816(.064)} = .244''$

$I_{NA} = \dfrac{.88(.064)^3}{12} + .0563(.212)^2 + \dfrac{.064(.816)^3}{12} + .0521(.228)^2$ .85

$= .00816$ in^4



SECTION A-A

FORM 1319A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO. 7/0583/8	
C-105	FRONT SPAR ANALYSIS.	SHEET NO 469	
		PREPARED BY	DATE
		L. MATALON.	5-10-55
		CHECKED BY	DATE

CHECK TRANSFER OF RIB LOAD TO FRONT SPAR

CHECK OF ANGLE ATTACHMENT TO RIB #3 (CONT'D)

$$P_{y_{1-5}} = \frac{6064}{5} = 1213\ \#$$

$$P_{y_{6-10}} = -1213\ \#$$

$$P_{x'_{1-5}} = \frac{M_{zz}'(y)}{\Sigma y^2} = \frac{3350\,(y)}{5.63} = 595\,y$$

$$P_{z_{6-10}} = \frac{M_{xx}(y)}{\Sigma y^2} = \frac{2250\,(y)}{5.63} = 400\,y$$

BOLT #	P_y	y	P_x'		BOLT #	P_y	y	P_z
1	1213	1.50	890		6	-1213	1.50	600
2	↑	.75	446		7	↑	.75	300
3		0	0		8		0	0
4	↓	-.75	-446		9	↓	-.75	-300
5	1213	-1.50	-890		10	-1213	-1.50	-600

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT NO. 7/0583/8 SHEET NO. 4-71	
		PREPARED BY	DATE
AIRCRAFT: C-105	FRONT SPAR ANALYSIS	L. MATALON	5-10-55
		CHECKED BY	DATE

CHECK TRANSFER OF RIB LOAD TO FRONT SPAR.

CHECK OF ANGLE ATTACHMENT TO RIB #3 (CONT'D)

CHECK OF SECTION A-A

$$M_{33}' = 2(1213)(.93-.38) - 890(.75) = 665 \text{ ''\#}$$

$$M_{xx} = 2(1213)(.75-.38) - 600(.75) = 450 \text{ ''\#}$$

$$\bar{x}' = \frac{.0686(.4245) + .0607(-.13)}{.0686 + .0607} = .164$$

$$\bar{z} = \frac{.0607(.375) + .0686(-.072)}{.0686 + .0607} = .138$$

$$I_{33'NA} = \frac{.081(.849)^2}{12} + .0686(.2605)^2 + .0607(.294)^2 = .0140 \text{ in}^4$$

$$I_{xxNA} = \frac{.081(.75)^3}{12} + .0607(.237)^2 + .0686(.210)^2 = .00926 \text{ in}^4$$

$$f_c = \frac{665(.695)}{.014} + \frac{450(.138+.223)}{.00926} = 50600 \text{ psi}$$

$$f_t = \frac{665(.425)}{.014} + \frac{450(.612)}{.00926} = 50000 \text{ psi}$$

$$F_t = 74000 \text{ psi}$$

$$MS = \frac{74000}{50600} - 1 = .46$$

.46

FORM 1319 A

AVRO-AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO. 7/0583/18
C-105	FRONT SPAR ANALYSIS	SHEET NO. 4-74

PREPARED BY	DATE
L. MATALON	6-1-55
CHECKED BY	DATE

CHECK TRANSFER OF RIB LOAD TO FRONT SPAR

CHECK OF ANGLE ATTACHMENT TO RIB #6

SINCE THE BOLT LOADS AT THE ANGLE ATTACHMENT TO RIB #6 ARE LESS THAN THAT TO RIB #3 AND SINCE THE ANGLE PROPERTIES ARE SIMILAR, NO FURTHER ANALYSIS IS NECESSARY.

CHECK OF ANGLE ATTACHMENTS TO RIBS # 1, 2, 4, 5, 7 & 8

AS SEEN ON PG. — THE LOADS AT THE ANGLE ATTACHMENTS TO RIBS # 1, 2, 4, 5, 7 & 8 ARE MUCH LESS THAN THE LOADS FOR THE ANGLE ATTACHMENTS TO RIBS 3 & 6. THE GAGE OF THE ANGLE ATTACHMENTS TO RIBS # 1, 4 & 5 IS .072", TO RIBS # 7 & 8 IS .064" & TO RIB # 2 IS .081".

THE ATTACHMENTS TO THESE ANGLES CAN BE 3/16 HUCK RIVETS.

NO FURTHER ANALYSIS FOR THESE ANGLE ATTACHMENTS IS NECESSARY.

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FRONT SPAR ANALYSIS	REPORT No. 7/0583/8	SHEET No. 4-77
		PREPARED BY: L. MATALON	DATE: 5-11-55
		CHECKED BY:	DATE:

CHECK OF F/S WEB (CONT'D)

b) STA 46-60 ($t = .072$)

$q = 670\ \#/in$ (REF_ P6_)

σ_b @ SKIN LINE = 23000 psi (REF_ P6_)

h @ SKIN LINE = 5.98"

h @ RIVET LINE = 5.98 - 1.50 = 4.48

f_b @ RIVET LINE = $23000\left(\frac{4.48}{5.98}\right) = 17200$ psi

$f_s = 670/.072 = 9320$ psi

$F_b = 21.6E\left(\frac{t}{b}\right)^2 = 21.6(10.3)10^6\left(\frac{.072}{4.48}\right)^2 = 57400$ psi

$F_s = 4.84E\left(\frac{t}{b}\right)^2 = 12800$ psi

$R_b = \frac{17200}{57400} = .30$

$R_s = \frac{9320}{12800} = .73$

$MS = \frac{5.2}{4.0} - 1 = .30^*$

REF_ INTERACTION CURVE

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO. 7/0583/8	SHEET NO. 4-78
C-105	FRONT SPAR ANALYSIS	PREPARED BY: L. MATALON	DATE: 5-11-55
		CHECKED BY	DATE

CHECK OF F/S WEB (CONT'D)

c) F/S STA 116-122 $(t = .072)$

BETWEEN STA 116 & 122 THERE IS A HIGH LOCAL SHEAR FLOW IMPOSED BY RIB #3 & RELIEVED BY SPAR #14.

$q = 1420\ \#/\text{in}$ (REF. P4)

σ_b @ SKIN LINE = 27000 psi (REF - P4

h @ SKIN LINE = 4.88"

h @ RIVET LINE = 4.88 - 1.50 = 3.38"

f_b @ RIVET LINE = $27000\left(\frac{3.38}{4.88}\right) = 18700$ psi

$f_s = \frac{1420}{.072} = 19700$ psi

$F_b = 21.6\,E\left(\frac{t}{b}\right)^2 = 21.6\,(10.3)(10)^6\left(\frac{.072}{3.38}\right)^2 = 101000 \leq 74000$ psi

$a/b = \frac{6}{3.38} = 1.78$

$F_s = K\frac{\pi^2 E}{12(1-\mu^2)}\left(\frac{t}{b}\right)^2$ } REF BRUHN

WHERE $K = 6.8$

$F_s = 6.8\,\frac{\pi^2(10.3)10^6}{12(1-.3^2)}\left(\frac{.072}{3.38}\right)^2 = 28800$ psi

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO. 7/0582/8	
C-105	FRONT SPAR ANALYSIS	SHEET NO 4-80	
		PREPARED BY	DATE
		L. MATALON	5-12-55
		CHECKED BY	DATE

CHECK OF WEB ATTACHMENTS TO FRONT SPAR CAPS

THE SHEAR FLOW IN THE WEB DOES NOT EXCEED 670 #/IN EXCEPT LOCALLY BETWEEN F/S STATIONS 116 TO 122 WHERE THE SHEAR FLOW IS EQUAL TO 1420 #/IN.

THE ATTACHMENTS ARE 3/16 AD RIVETS

RIVET ALLOWABLE = 862 #

RIVET PITCH = .88

$$q_{ALL} = \frac{862}{.88} = 980 \text{ #/IN}$$

a) @ ALL STATION EXCEPT STA 116-122

$$MS_{MIN} = \frac{980}{670} - 1 = .46$$ .46

b) @ STA 116-122

MAKE WEB ATTACHMENTS 3/16 HI-SHEAR

SHEAR ALLOWABLE = 2070 #

BEARING ALLOWABLE = 125000(.1875)(.072) = 1690 #

RIVET PITCH = .88

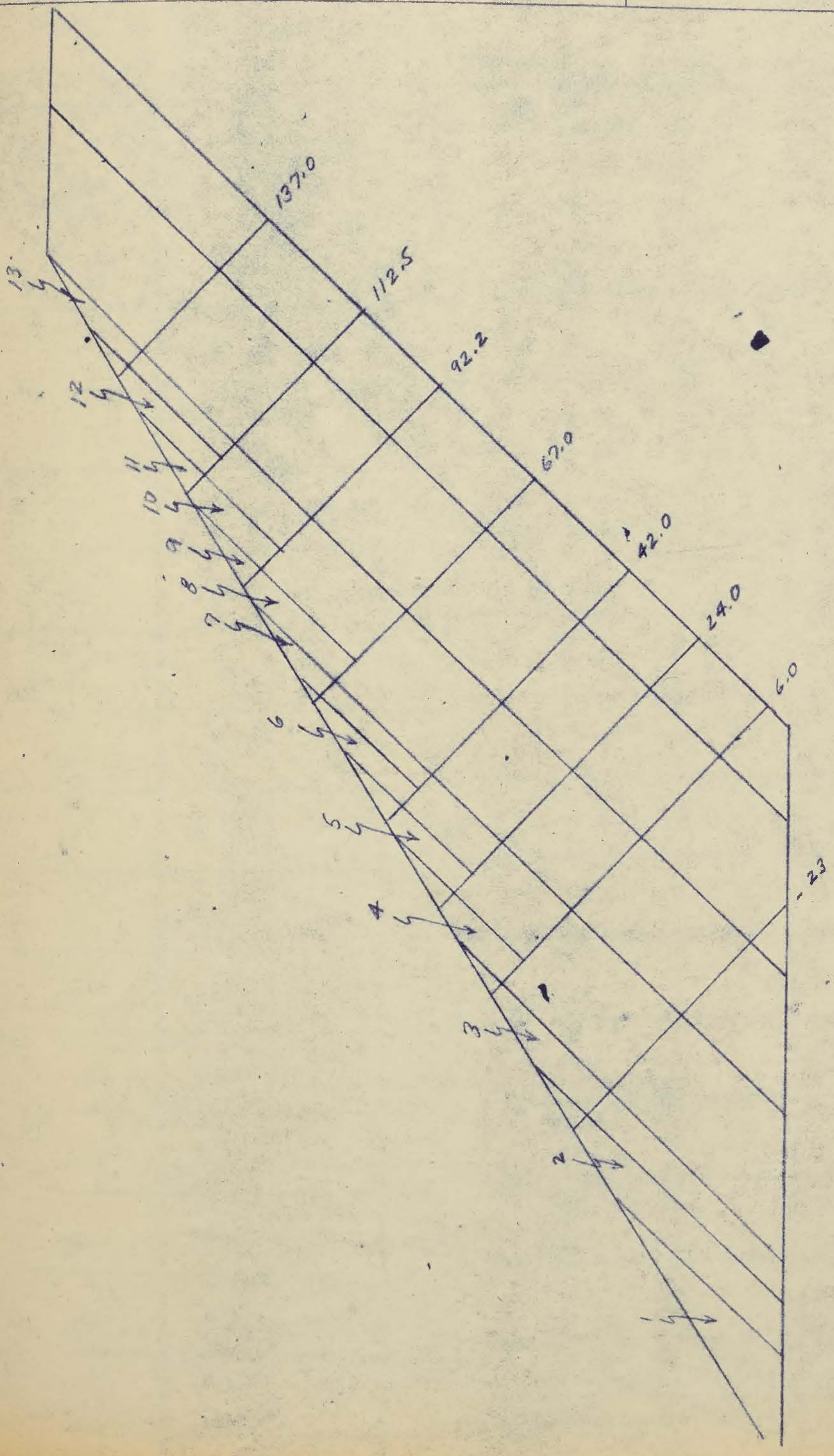
$$q_{ALL} = \frac{1690}{.88} = 1920 \text{ #/IN}$$

$$MS = \frac{1920}{1420} - 1 = .35$$ .35

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT No. 7/0583/8
C 105	FIN	SHEET No 4-81
		PREPARED BY: C Gundasen — DATE:
		CHECKED BY: — DATE:



FORM 1919A

A. V. R

AIRCRAFT

WEIGHT

C. G. POS

C105 FIN.

CHECK OF SKIN PANELS, (ADJACENT TO FRONT SPAR) FOR BUCKLING

	1	2	3	4	5	6	7	8	9	10	
PANEL	b	t	b/t	a	b/a	F_{cr}	f_c	RATIO f_c/F_{cr}	$F_{scr} = \frac{5.35\pi^2 E}{12(1-\mu^2)}\left(\frac{t}{b}\right)^2$ (GERHARD) EDGES ... PINNED	q LB/IN	f
1	3.5	.115	30.5	34	0.10	36,000	23,300	0.65	43,000	763	66
2	7.5	.104	72	44	0.17	7000	23,700	3.4		763	7
3	6.0	.094	64	22	0.27	9000	23,700	2.63		146	1
4	4.0	.096	42	18	0.22	22,000	28,200	2.56		890	10
5	4.5	.090	50	18	0.25	15,500	23,000	2.46		740	9,
6	4.5	.084	53	18	0.25	14,000	24,000	2.40		640	8
7	4.0	.077	52	8	0.50	14,500	20,500	2.05		330	5
8	5.0	.139	36	24	0.21	27,500	20,500	0.745	39,350	1003	7
9	3.0	.136	22	8	0.37	46,000	16,500	0.36	43,000	583	4
10	6.0	.132	45	20	0.30	18,500	16,500	0.91	25,000	583	4
11	3.0	.127	24	22	0.14	43,500	13,500	0.32	43,000	360	2
12	5.4	.123	42.5	28	0.19	20,500	13,500	0.66	28,000	360	29
13	4.5	.113	40	28	0.16	23,000	8000	0.347	31,700	303	2

FORM 1543

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	7/0583/8
SHEET No.	4-85
AIRCRAFT:	C-105
	FRONT SPAR ANALYSIS
PREPARED BY	L. MATALON
DATE	5-26-55
CHECKED BY	
DATE	

CHECK OF SKIN ATTACHMENTS TO FRONT SPAR

3/16 FA 200 TO BOLTS @ 1.0" PITCH

$q = 1260 \ \#/in$ (REF Pg)

SHEAR ALLOWABLE = 1595# (REF)

BEARING ALLOWABLE ON .096" SKIN

$= 125000(.096)(.1875) = 2250\#$

$MS = \frac{1595}{1260} - 1 = .26$ .26

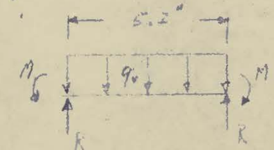
CHECK OF FRONT SPAR FLANGE

$\sigma_{xx} = 27000 \ psi$ } REF Pg

$q_v = 890 \ \#/in$

IT IS ASSUMMED THAT BUCKLING OF THE SKIN UNDER THE COMPRESSIVE LOAD FORMS BUCKLES BETWEEN THE POSTS. THE UNBUCKLED SKIN BY THE POSTS THEREFORE SERVE AS SUPPORTS FOR THE FRONT SPAR CAP.

THE POST SPACING IN THIS REGION IS 5.3".



$M = \frac{1}{12} q_v l^2 = \frac{1}{12} 890 (5.3)^2$

$= 1920 \ ''\#$

$R = \frac{890(5.3)}{2} = 2360\#$

FORM 1319 A

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT NO. 7/0583/8 SHEET NO. 4-86	
AIRCRAFT: C-105	FRONT SPAR ANALYSIS.	PREPARED BY: L. MATALON	DATE: 5-26-55
		CHECKED BY:	DATE:

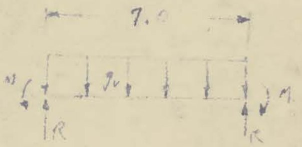
CHECK OF FRONT SPAR FLANGE (CON'D)

THE UNBUCKLED SKIN IS CHECKED FOR COLUMN ACTION ASSUMING A 1.0" STRIP.

$$P_{CR} = \frac{A\pi^2 E}{(L/\rho)^2} = \frac{(.096)\pi^2 10.3(10)^6}{\left(\frac{4}{\sqrt{\frac{.096^2}{12}}}\right)^2} = 465^{\#}$$

IT IS APPARENT THAT THE UNBUCKLED SKIN WILL NOT SERVE AS SUPPORTS FOR THE FRONT SPAR CAP, THEREFORE INTERMEDIATE STIFFENERS WILL BE USED BETWEEN THE RIBS.

a) H/C STA 6.0 TO 24.0 - ADD STIFFENER* @ H/C STA 17.0



$q_v = 890\ ^{\#}/_{IN}$

$\sigma_c = 27000$ psi (DUE TO FIN BENDING)

$M = \frac{1}{12} q_v l^2 = \frac{1}{12}(890)(7.0)^2 = 3640\ ^{"\#}$

$f_c = \frac{3640\,(1.15)}{.113} + 27000 = 64200$ psi

$F_{tu} = 78000$ psi

$MS = \frac{78000}{64200} - 1 = .21$ .21

* I.C. STIFFENERS ARE SUGGESTED ON SKIN BETWEEN F/SPAR & NEXT SPAR AFT, SEE SHT. 4-88.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FRONT SPAR ANALYSIS	REPORT NO. 7/0583/8	SHEET NO. 4-87
		PREPARED BY: L. MATALON	DATE: 5-26-55
		CHECKED BY:	DATE:

CHECK OF FRONT SPAR FLANGE (CONT'D)

b) H/$\mathcal{L}$ STA -37 TO -23 (ADD STIFFENERS @ H/$\mathcal{L}$ STA -37 & -30)

$b_{AV.} = 4.75$ $q = 763$ #/IN (REF Pg)

$t_{AV} = .103$

$$F_{CR} = 3.6\,E\left(\frac{t}{b}\right)^2 = 3.6\,(10.3)(10)^6\left(\frac{.103}{4.75}\right)^2 = 17500 \text{ psi}$$

$\sigma_c = 25000$ psi (DUE TO FIN BENDING) REF Pg.

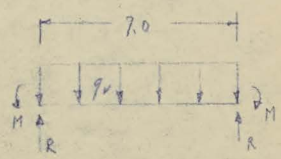
SINCE PANEL BUCKLES UNDER THE COMPRESSIVE LOAD THE SHEAR IS CARRIED IN THE WEB BY DIAGONAL TENSION.

$\alpha = 45°$

$q_v = q \tan\alpha = 763$ #/IN

$q_H = 763$ #/IN

$$q_{TOTAL} = \sqrt{763^2 + 763^2} = 1080 \text{ \#/IN}$$



$$M = \frac{1}{12} q_v \ell^2 = \frac{1}{12}(763)(7.0)^2 = 3110 \text{ \#"}$$

$$f_c = \frac{3110\,(1.15)}{.113} + 25000 = 56700 \text{ psi}$$

$F_t = 78000$ psi

$$MS = \frac{78000}{56700} - 1 = .37$$

.37

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/0583/8	
		SHEET No. 4-48	
AIRCRAFT: C-105	FRONT SPAR ANALYSIS	PREPARED BY L. MATALON	DATE 5-26-55
		CHECKED BY	DATE

ADDITIONAL LOAD ON FRONT SPAR DUE TO SKIN BUCKLING

SUMMARY

THOUGH CALCULATIONS INDICATE THAT STIFFENERS SEEM TO BE NECESSARY WHEN A PANEL ADJACENT TO THE FRONT SPAR BUCKLES, TESTS RUN ON TWO TEST BOXES SHOW NO APPARANT FAILURE OF THE END SPAR CAPS. THIS SEEMS TO INDICATE THAT QUITE A BIT OF THE BUCKLED SKIN ACTS WITH THE SPAR CAP IN BENDING.

CONFERENCE BETWEEN MR. MITCHELL & MR O'DOUHERTY OF 5-26-55 ON ABOVE POINT BROUGHT A DECISION OF NO STIFFENERS.

FORM 1319A

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/0583/8 SHEET No. 5-1	
AIRCRAFT:		PREPARED BY	DATE
C-105	FIN. ACCESS-DOOR	L. MATALON	5-12-55
		CHECKED BY	DATE

INTRODUCTION

THERE ARE EIGHT ACCESS DOORS ON THE FIN, ALL OF WHICH, EXCEPT FOR THE JACK ACCESS DOOR FALL WITHIN THE PANELS ESTABLISHED BY THE SPAR & RIB SPACING. THIS NESSESITATES AN ADDITIONAL CHECK ON THE JACK ACCESS DOOR & THE SKIN OPPOSITE THE JACK ACCESS DOOR FOR COMBINED SHEAR AND COMPRESSION BUCKLING.

THE ACCESS DOORS ARE ASSUMED TO BE 100% EFFECTIVE IN CARRYING THRU THE SHEAR AND 50% EFFECTIVE IN CARRYING THRU THE AXIAL LOAD.

THE SHEAR AND COMPRESSION BUCKLING OF THE JACK ACCESS DOOR AND THE SKIN OPPOSITE TO IT IS ANALYZED BY THE METHOD LISTED IN TIMOSHENKO'S "THEORY OF ELASTIC STABILITY" OF A PANEL WITH SEVERAL FLEXIBLE LATERAL STIFFENERS UNDER LONGITUDINAL COMPRESSION.

DOUBLERS EQUAL IN CROSS SECTIONAL AREA TO 50% OF THE ACCESS DOOR ARE ADDED AROUND THE STRUCTURE IN ORDER TO ENABLE THE REMAINING AXIAL LOAD TO GO THRU THE DOUBLERS WITHOUT CAUSING ADDITIONAL STRESS ON THE SURROUNDING STRUCTURE.

THE METHOD USED IN DETERMINING THE TRANSFER OF THE AXIAL LOAD TO THE DOUBLER WAS TAKEN FROM "NACA ARR 3J02" WHICH ESTABLISHES THE LOAD DISTRIBUTION AROUND A RECTANGULAR CUT-OUT WITHOUT REINFORCEMENT. THE METHOD WAS ADAPTED TO THIS CASE BY ASSUMING THAT ALL THE LOAD WENT THRU THE DOUBLER AND THUS INCREASING THE LOAD DISTRIBUTION AROUND THE CUT-OUT TO MEET THIS REQUIREMENT.

THE CHORDWISE ATTACHMENTS ON THE ACCESS DOORS WERE ANALYZED AS BEING 60% EFFECTIVE IN CARRYING THRU THE AXIAL LOAD.

FIN SKIN OPP. ACCESS DOOR

CRIPPLING STRESS OF A PANEL WITH SEVERAL FLEXIBLE LATERAL STIFFENERS UNDER LONGITUDINAL COMP.

REF. S. TIMOSHENKO "THEORY OF ELASTIC STABILITY" PG. 379

THE APPROX. FORMULA FOR THE CRITICAL STRESS FOR A PANEL WITH FLEXIBLE RIBS OF EQUAL RIGIDITY SO THAT THERE WILL BE SEVERAL RIBS FOR EACH HALF-WAVE OF THE BUCKLED PLATE

$$\sigma_{cr} = \frac{\pi^2 D}{b^2 t} \frac{(m^2+\beta^2)^2 + r\delta\beta^3}{\beta^2 m^2}$$

"m" IS THE NUMBER OF HALF WAVES AND SHOULD BE TAKEN SUCH THAT σ_{cr} IS A MINIMUM

TO ESTABLISH MINIMUM σ_{cr} DIFFERENTIATE WITH RESPECT TO "m" AND EQUATE TO ZERO

$$m = \beta \left(1 + \frac{r\delta}{\beta}\right)^{\frac{1}{4}}$$

r = NO. PANELS, THEREFORE r-1 IS THE NO. OF STIFFENERS.

TAKE r = 16

$$m = 5.26 \left(1 + \frac{16 \times 9.85}{5.26}\right)^{\frac{1}{4}}$$

$$= 5.26 (29.75)^{\frac{1}{4}} = 5.26 \times 2.33 = 12.25.$$

LET m = 12

THEREFORE THERE WILL BE $\frac{15}{12}$ = 1.25 STIFFENERS PER ONE-HALF WAVE LENGTH.

A.V.ROE CANADA LIMITED MALTON – ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. 7/0583/18 SHEET NO. 5-6	
		PREPARED BY: H. N. SHOJI	DATE: MAR 30/55
AIRCRAFT C105	JACK ACCESS DOOR FIN	CHECKED BY:	DATE:

SKIN OPP. ACCESS DOOR

THE FIRST OBVIOUS STEP TO TAKE IS TO REDUCE THE EFFECTIVE PANEL WIDTH 'b' BY CHANGING THE ANGLE STIFFENER ALONG THE FWD EDGE OF THE PANEL TO A "TEE".

TAKE $b = 8.50$ IN.

$D = 3210$ $= 48.2$

$\beta = \frac{48.4}{8.50} = 5.70$

$\gamma = 9.45 \times \frac{9.2}{8.50} = 10.22$

$\delta = .1116 \times \frac{9.2}{8.50} = .1208$

$m = 5.70\left(1 + \frac{16 \times 10.22}{5.70}\right)^{\frac{1}{4}}$

$= 5.70\,(29.75)^{\frac{1}{4}} = 5.70 \times 2.33 = 13.30$

LET $m = 13$

THEREFORE, THERE WILL BE $\frac{15}{13} = 1.15$ STIFFENERS PER ONE-HALF WAVE LENGTH

$\sigma_{cr} = \frac{\pi^2 \times 3210}{8.5^2 \times .152} \; \frac{(13^2 + 5.70^2)^2 + 16 \times 10.22 \times 5.70^3}{5.70^2 \times 13^2}$

$= 2880 \; \frac{40,200 + 30,300}{5500}$ (73,?00)

$= \underline{38,700 \text{ psi}}$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C105	JACK ACCESS DOOR	REPORT NO. 7/0/22/8
		SHEET NO. 58
		PREPARED BY: H.N. SHETI — DATE: April 25/5[illegible]
		CHECKED BY: — DATE:

ALLOWABLE BUCKLING OF DOOR

ASSUMPTIONS:

1) STIFFENER ARRANGEMENT ON THE DOOR IS THE SAME AS FOR OPPOSITE SKIN.
2) DOOR SKIN GAUGE REDUCED TO .102 IN
3) 50% OF TOTAL END LOAD TAKEN BY THE DOOR BUT 100% OF THE SHEAR

STIFFENER $I_{xx} = .0279 \text{ IN}^4$

$$D = \frac{Et^3}{12(1-\nu^2)} = \frac{10\times10^6 \times .102^3}{12(1-.3^2)} = 972$$

$$\beta = \frac{45.4}{9.2} = [illegible]$$

$$\gamma = \frac{B}{bD} = \frac{EI}{bD} = \frac{10\times10^6\times.0279}{9.2\times972} = 31.2$$

$$\delta = \frac{A}{bh} = \frac{.1500}{9.2\times.102} = .16$$

APPLIED STRESSES:

AVERAGE AXIAL STRESS IN .152 IN SKIN = 29,000 psi

TOTAL END LOAD = 29,000 × .152 = 4410 LB/IN.

50% OF THIS LOAD GOES THROUGH THE DOOR

LOADING = $\frac{4410}{2}$ = 2205 LB/IN

STRESS IN .102 DOOR

$$\sigma_z = \frac{2205}{.102} = 21,600 \text{ psi}$$

SHEAR FLOW q = 1300 LB/IN.

SHEAR STRESS $\tau = \frac{1300}{.102}$ = 12,750 psi

CHORDWISE LOADING = 500 LB/IN.

CHORDWISE STRESS $\sigma_x = \frac{500}{.102}$ = 4900 psi

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7/0583/1
SHEET No. 5-12

PREPARED BY	DATE
H.N. Shosi	Apr. 29/55
CHECKED BY	DATE

AIRCRAFT: C105

JACK ACCESS DOOR

7-1022-1467

ALLOWABLE BUCKLING OF DOOR

DOOR THICKNESS = .125 IN.

$D = 972 \times \left(\frac{.125}{.102}\right)^3 = 1788$

$\beta = 5.26$

$\gamma = 31.2 \times \frac{972}{1788} = 17.0$

APPLIED STRESSES

$\sigma_z = \frac{2205^*}{.125} = 17,650 \text{ psi}$

$\tau = \frac{1300^*}{.125} = 10,400 \text{ psi}$ * REF. SHT 8

$\sigma_x = \frac{500^*}{.125} = 4000 \text{ psi}$

CRIPPLING UNDER AXIAL COMPRESSION

$m = \beta\left(1 + \frac{\gamma}{\beta}\right)^{1/2}$

$= 5.26\left(1 + \frac{17 \times 17}{5.26}\right)^{\frac{1}{4}} = 5.26 \times 2.72 = 14.3$ SAY 14

THEREFORE, THERE WILL BE $\frac{16}{14} = 1.14$ STIFFENERS PER ONE-HALF BUCKLED WAVE LENGTH.

$\sigma_{zcr} = \frac{\pi^2 D}{b^2 t} \frac{(m^2+\beta^2)^2 + \gamma \beta \beta^2}{\beta^2 m^2}$

$= \frac{\pi^2 \times 1788}{9.2^2 \times .125} \frac{(14^2 + 5.26^2)^2 + 17 \times 17 \times 5.26^3}{5.26^2 \times 14^2}$

$= 1668 \times \frac{50,600 + 42,900}{5420} = 1668 \times 17.25$

$= 29,000 \text{ psi}$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	7/0583/18
SHEET No.	5-13
AIRCRAFT	C105
	JACK ACCESS DOOR
PREPARED BY	H N Shozi
DATE	Apr. 29/55
CHECKED BY	
DATE	

ALLOWABLE BUCKLING OF DOOR

SHEAR BUCKLING

THE STIFFENERS ARE STILL SATISFACTORY FOR DIVIDING THE DOOR INTO 5.66 IN PANEL WIDTHS.

$$\tau_{cr} = 4.84 \times 10^7 \times \left(\frac{.125}{5.66}\right)^2 = 4.84 \times 10^7 \times 48.8 \times 10^{-5}$$

$$= \underline{23{,}600 \text{ psi}}$$

STRESS RATIOS

CHORDWISE COMPRESSION STRESS IS VERY SMALL AND THEREFORE WILL BE NEGLECTED

$$\frac{\sigma_z}{\sigma_{cr}} = \frac{17{,}650}{29{,}000} = .61$$

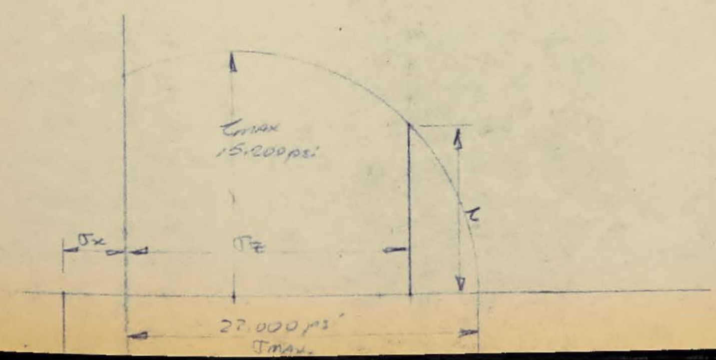
$$\frac{\tau}{\tau_{cr}} = \frac{10{,}400}{23{,}600} = .445$$

FROM THE INTERACTION CURVE: FOR RATIO OF $\frac{\tau/\tau_{cr}}{\sigma/\sigma_{cr}} = \frac{.445}{.61} = .73$

MAX. ALLOWABLE $\frac{\tau}{\tau_{cr}} = .72$

$$M.S. = \frac{.72}{.61} - 1.00 = \quad .18$$

PRINCIPAL STRESS (MOHR'S CIRCLE)



M.S. >1.00

CHECK OF STRESSES AROUND CUT-OUT (CONT'D)

$A_1 = 2.43 \text{ in}^2$
$A_2 = .543 \text{ in}^2$
$A_3 = .875 \text{ in}^2$
$b_1 = 8.3''$
$b_2 = 5.0''$
$t_1 = t_2 = .161''$

} Ref. –

$$K_1^2 = \frac{Gt}{Eb_1}\left(\frac{1}{A_1} + \frac{1}{A_2}\right) = \frac{3.9(10)^6(.161)}{10.3(10)^6(8.3)}\left(\frac{1}{2.43} + \frac{1}{.543}\right)$$

$$= \underline{.0164}$$

$$K_2^2 = \frac{Gt}{Eb_2}\left(\frac{1}{A_2} + \frac{1}{A_3}\right) = \frac{3.9(10)^6(.161)}{10.3(10)^6(5.0)}\left(\frac{1}{.543} + \frac{1}{.875}\right)$$

$$= \underline{.0363}$$

$$K_3 = \frac{Gt}{Eb_1A_2} = \frac{3.9(10)^6(.161)}{10.3(10)^6(8.3)(.543)} = \underline{.01355}$$

$$K_4 = \frac{Gt}{Eb_2A_2} = \frac{3.9(10)^6(.161)}{10.3(10)^6(5.0)(.543)} = \underline{.0226}$$

$$\bar{K} = \sqrt{K_1^2K_2^2 - K_3K_4} = \sqrt{(.0164)(.0363) - (.01355)(.0226)} = .0170$$

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT NO. 70583/8 SHEET NO. 5-16	
AIRCRAFT: C-105	FIN ACCESS DOOR (JACK)	PREPARED BY L. MATALON	DATE 3-22-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUTOUT (CONT'D.)

$$B = \sqrt{\frac{K_1^2 + K_1^2 + 2\bar{K}}{K_1^2 + K_2^2 + 2\bar{K} - \frac{K_3 K_4}{K_1^2}}} = 1.13$$

$$D = \sqrt{K_1^2 + K_2^2 + 2\bar{K}} = .294$$

$$K_1 L = \sqrt{.0164}\,(25.0) = 3.2$$

$$R = .47$$

$$\frac{K_1^2 K_2^2}{K_3 K_4} = \frac{(.0164)(.0363)}{.01355(.0226)} = 1.94$$

$$\frac{\bar{K}}{K_2^2} = \frac{.0170}{.0363} = .469$$

$$C_0 = .56$$

50% AVERAGE STRESS IN THE GROSS SECTION

$$\sigma_0 = .50(34500) = 17250 \text{ psi} \quad (\text{Ref. } 70583/8 \ \text{5.14})$$

50% AVERAGE STRESS IN NET SECTION

$$\bar{\sigma} = \frac{\sigma_0 (A_1 + A_2 + A_3)}{A_1 + A_2} = \frac{17250(2.43 + .543 + .875)}{(2.43 + .543)} = 22400 \text{ psi}$$

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (JACK)	REPORT NO. 7/0[illegible]/18 SHEET NO. 5-17	
		PREPARED BY: L. MATALON	DATE: 3-23-55
		CHECKED BY:	DATE:

CHECK OF STRESSES AROUND CUT-OUT (CONT'D.)

MAXIMUM STRESS IN THE STRINGER BORDERING THE CUT-OUT -

a) WITHOUT DOUBLER

$$\sigma_{2R} = \bar{\sigma}(1 + RC_0) + \sigma_0$$

$$= 22400\,[1 + (.47)(.56)] + .50(34500)$$

$$= 45550 \text{ psi}$$

b) WITH DOUBLER

$A_2 = .543 \text{ in}^2$ (REF. P[illegible]) ✓

TOTAL DOUBLER AREA = $.156(5.0) = .78 \text{ in}^2$

LOAD THRU DOUBLER = $\sigma_0 \, 2A_3 = 17250(2)(.875)$

$= 30200$ #

$$\sigma_{2R} = \frac{34500(.543) + 30200}{.543 + .78}$$

$$= 37700 \text{ psi}$$

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7/0583/8

SHEET No. 5-20

AIRCRAFT		PREPARED BY	DATE
C-105	FIN ACCESS DOOR (JACK)	L. MATALON	4-13-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT-OUT

SHEAR FLOW ALONG DISCONTINUOUS PANEL

a) SPANWISE RATE OF DECAY OF SHEAR FLOW (CONT'D)

TOTAL LOAD GOING THRU DOUBLER

$$P = 30{,}200\ \# \quad (\text{REF } Pg\ 5/17)$$

∴ EACH LEG OF THE DOUBLER SHOULD PICK UP HALF OF THE ABOVE LOAD. IT IS SEEN FROM THE CURVE ON PAGE _ THAT EACH LEG OF THE DOUBLER, WHICH IS 13" IN LENGTH, CAN PICK UP APPROXIMATELY 12,000 # DIRECTLY FROM THE SKIN OR A TOTAL OF 24000 #. THE RATIO OF THE TWO LOADS ARE USED TO CORRECT THE CURVE.

$$K = \frac{30200}{24000} = 1.26$$

$$q_{y\,CORR} = K q_y = 1.26\, q_y$$

y	q_y	$q_{y\,CORR.}$
0	-2450	-3080
2	-1690	-2130
4	-1150	-1450
7	-660	-830
10	-375	-470
13	-214	-270

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO. 71/S&S/?
C-105	FIN ACCESS DOOR (JACK)	SHEET NO 5-22
		PREPARED BY: L. MATALON — DATE: 4-5-55
		CHECKED BY: — DATE:

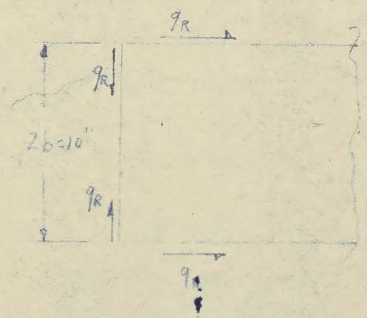
CHECK OF STRESSES AROUND CUT-OUT

SHEAR FLOW ALONG DISCONTINUOUS PANEL (CONT'D)

b) CHORDWISE RATE OF DECAY OF SHEAR FLOW (q_R)

THE CHORDWISE SHEAR FLOW AT THE CUT-OUT ALONG THE DISCONTINUOUS PANEL HAS BEEN FOUND BY TEST RESULTS TO APPROXIMATE A CUBIC PARABOLA VARYING FROM THE MAXIMUM AT THE BORDER OF THE CUT-OUT TO ZERO AT THE CENTER (REF)

$q_{R_{CORR.}} = -3080$ #/IN (REF. PG. 5/20)



$$q_x = q_{R_{CORR}}\left[1 - \frac{x}{b}\right]^3$$

$$= -3080\left[1 - \frac{x}{5.0}\right]^3$$

①	②	③
x	$\left[1-\frac{x}{5.0}\right]^3$	q_x
REF		-3080 ②
0	1	-3080
1	.512	-1590
2	.216	-670
3	.064	-200
4	.008	-25
5	0	0

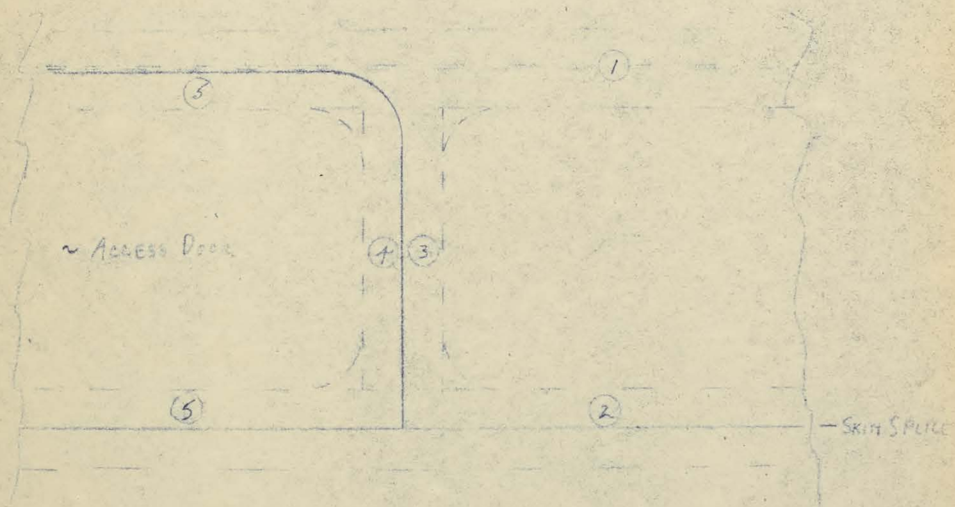
AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/[illegible]/18		
SHEET NO. 5.24		
AIRCRAFT: C-105	Fin Access Door (Jack)	
PREPARED BY	DATE	
L. Matalon	4-5-55	
CHECKED BY	DATE	

Check of Stresses Around Cut-Out

Rivet Attachments



AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (JACK)	REPORT No. 7/0532/18	SHEET No. 5.25
		PREPARED BY: L. MATALON	DATE: 4-5-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT-OUT

RIVET ATTACHMENTS (cont'd)

a) @ POINT ①

THERE IS A DOUBLE ROW OF ATTACHMENTS TO TRANSMIT THE LOAD FROM THE SKIN TO THE DOUBLER @ 1.0" PITCH, BOTH ROWS HAVE 3/16 HI-SHEAR RIVETS.

$q_{J_{CORR}} = q_1 = 3080 \ \#/in$ (REF P)

ALLOWABLES

1) 3/16 HI SHEAR RIVET = 2120 # (REF)

TOTAL ALLOWABLE = 2(2120) = 4240 #/in

$MS = \frac{4240}{3080} - 1 = .37$ .37

b) @ POINT ②

THERE IS A SPANWISE SKIN SPLICE @ POINT 2, THEREFORE THE RIVET ATTACHMENT TRANSMITS BOTH THE q_R DUE TO TRANSFER OF 50% OF THE AXIAL LOAD THRU THE DOUBLER AND THE q_S DUE TO FIN BENDING & TORSION.

$q_2 = q_R + q_S = 3080 + 1100 = 4180 \ \#/in$

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/0583/18
SHEET NO. 5-26

AIRCRAFT:		PREPARED BY	DATE
C-105	FIN ACCESS DOOR (JACK)	L. MATALON	4-6-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT-OUT

RIVET ATTACHMENTS

b) @ POINT (2) (CONT'D)

5/16 HI-SHEAR RIVETS @ ~~1.0"~~ .98" PITCH

ALLOWABLE/RIVET = $\frac{5000^{\#}}{.98}$ (REF) = 5100 #/"

$$MS = \frac{5100}{4180} - 1 = .19$$ .19

c) @ POINT (3).

THE CHORDWISE ATTACHMENT OF POINT (3) TRANSMITS 60% OF THE AXIAL LOAD THRU THE ACCESS DOOR ALSO THE SHEAR FLOW DUE TO FIN BENDING & TORSION AND HALF THE SHEAR FLOW DUE TO TRANSFER OF 50% OF THE AXIAL LOAD THRU THE DOUBLER.

$$q_3 = \sqrt{(1.2\,\sigma_0 t)^2 + (q_s + q_R/2)^2}$$

$$= \sqrt{(3320)^2 + (1100 + \frac{3080}{2})^2} = 4230^{\#}/in$$

SINGLE ~~DOUBLE~~ ROW OF ATTACHMENTS

i) ROW OF 1/4 NAS LOCKBOLTS @ 1.0" PITCH

~~ii) ROW OF 1/4 HI-SHEAR RIVETS @ 1.0" PITCH~~

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (JACK)	REPORT No. 7/0552/18	SHEET No 5-27
		PREPARED BY: L. MATALON	DATE: 4-6-55
		CHECKED BY:	DATE:

CHECK OF STRESSES AROUND CUT-OUT

RIVET ATTACHMENTS -

c) @ POINT (3) (CONT'D)

ALLOWABLES OF -

1) 1/4" NAS LOCK BOLTS

SHEAR ALLOWABLE = 4650# (REF

BEARING ALLOWABLE ON .156 THICK 75 ST-6 ALCLAD SKIN

= 141000 (.25)(.156) = 5500#

2) ~~1/4 HI-SHEAR RIVETS~~

~~ALLOWABLE = 3680# (REF)~~

~~TOTAL ALLOWABLE = 4600 + 3680 = 8280 #/IN~~

$MS = \frac{4650}{4230} - 1 = .10$ (.10)

FOR TRUE MARGIN, ETC.,
SEE CALCS. ON RIB 4 - DRG. 7-1083-815.

FORM 1319A

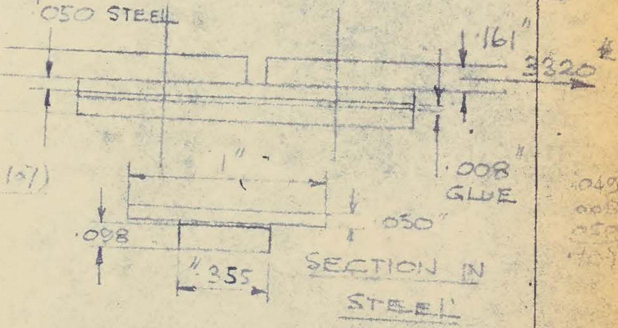
A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT No. 7/0583/8 SHEET No. 5/29 A	
AIRCRAFT: C. 105.	FIN. ACCESS DOOR (JACK	PREPARED BY: J.A.O'J & A.S.	DATE: 17-11-55
		CHECKED BY	DATE

CHORDWISE SPLICE PLATE.

STEEL STRIP .050".
DRG. 7.1053 - 1481 / 1449
MAT^L:- MIL/S/5059. (HALF HARD)

SPANWISE LOAD/IN = 3320 #/"
(SHT. 5-28 (d))

CHORDWISE SPI = 1220 #/"
(SHT. 5-29 (e))



$\bar{y} = \dfrac{(1 \cdot .050 \cdot .025) + (.355 \cdot .098 \cdot .107)}{.05 + .0348}$

$= \dfrac{.00125 + .00372}{.0848} = \dfrac{.00497}{.0848}$

$= .0587$ INS.

$I_{NA} = (.05 \times .0337^2) + (.0348 \times .0483^2) + \left(\dfrac{.05^3}{12}\right) + \left(\dfrac{.355 \times .098^3}{12}\right)$

$= .0000568 + .0000806 + .0000104 + .0000279$

$= .0001757$ INS^4.

Z TOP OF STEEL $= \dfrac{.0001757}{.0587} = .0030$ INS^3

Z BTM. OF ALUM^M $= \dfrac{.0001757}{.0973} = .00181$ INS^3.

OFFSET FROM N.A = .0587 + .0805 = .1392 INS.

$\therefore$ M = 3320 × .1392 = 462 IN. LB.

$\therefore f_{MAX.}$ IN STEEL $= \dfrac{3320}{.0848} + \dfrac{462}{.003}$

$= 39,150 + 154,000 = 193,150$ P.S.I.

ALSO $\tau_S = \dfrac{1220}{.0848} = 14,400$ P.S.I.

$\therefore R_{E.L.} = \dfrac{39,150}{150,000} = .261$

$R_B = \dfrac{154,000}{220,000} = .70$

$R_S = \dfrac{14,400}{80,000} = .18$

$\therefore MS_{NET} = \dfrac{1}{.261 + \sqrt{.70^2 + .18^2}} - 1$

$= \dfrac{1}{.984} - 1 = .016$

FORM 1319A

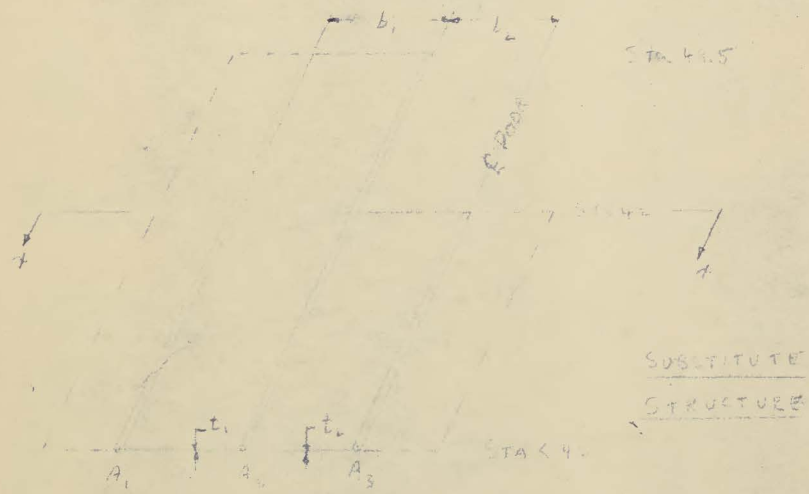
AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (LIMITER)	REPORT NO. 7/0?/?/1	SHEET NO. 5-33
		PREPARED BY: L. MATALON	DATE: 3-29-55
		CHECKED BY:	DATE:

CHECK OF STRESSES AROUND CUT-OUT (REF ...

ASSUME THE ACCESS DOOR TO BE 50% EFFECTIVE IN TRANSMITTING AXIAL LOAD, THEREFORE 50% OF THE LOAD IS CONSIDERED TRANSMITTED AROUND THE ACCESS DOOR THRU THE DOUBLER. THE CONTINUOUS STRINGER IN THE CENTER OF THE ACCESS DOOR IS NEGLECTED AT THE OUTSET OF THE ANALYSIS BUT TAKEN INTO CONSIDERATION AT THE LATTER PART.



SUBSTITUTE STRUCTURE

$A_1 = 1.37 \text{ in}^2$

$A_2 = .92 \text{ in}^2$

$A_3 = .93 \text{ in}^2$

$b_1 = 8.7 \text{ in}$

$l_2 = 6.0 \text{ in}$

$t_1 = t_2 = .155$

REF

CHECK OF STRESSES AROUND CUT-OUT (CONT'D)

50% OF AVERAGE STRESS IN GROSS SECTION

$$\sigma_0 = .50\,(36000) = 18000 \text{ psi (Ref [illegible])}$$

50% OF AVERAGE STRESS IN NET SECTION

$$\bar{\sigma} = \frac{\sigma_0\,(A_1 + A_2 + A_3)}{A_1 + A_2} = \frac{18000\,(1.97 + .92 + .93)}{1.97 + .92} = 23800 \text{ psi}$$

MAXIMUM STRESS IN STRINGER BORDERING THE CUT-OUT

a) WITHOUT DOUBLER

$$\sigma_{2R} = \bar{\sigma}\,(1 + RC_0) + \sigma_0$$

$$= 23800\,[1 + (.595)(.285)] + .50\,(36000)$$

$$= 45900 \text{ psi}$$

b) WITH DOUBLER

$$A_2 = .92 \text{ in}^2 \text{ (Ref P. [illegible])}$$

TOTAL DOUBLER AREA $= 6(.156) = .936$

LOAD THRU DOUBLER $= \sigma_0\, 2A_5 = 18000\,(2)(.93) = 33500$

$$\sigma_{2R} = \frac{36000(.92) + 33500}{(.92) + (.936)} = 36000^{\#}$$

ORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (LIMITER)	REPORT NO. 7/0-83/?	SHEET NO. 5-36
		PREPARED BY: L. MATALON	DATE: 3-30-55
		CHECKED BY:	DATE:

CHECK OF STRESSES AROUND CUT-OUT (CONT'D)

MAXIMUM SHEAR FLOW IN DISCONTINUOUS PANEL

a) @ RIB DUE TO TRANSFER OF 50% AXIAL LOAD THRU DOUBLER

$$T_{2_R} t_2 = -\sigma A_2 \frac{K_4}{D}\left(1 + RC_0 + \frac{K_1^2}{\bar{K}}\right)$$

$$= -23800(.92)\frac{.01063}{.238}\left[1 + .595(.285) + \frac{.0108}{.01221}\right]$$

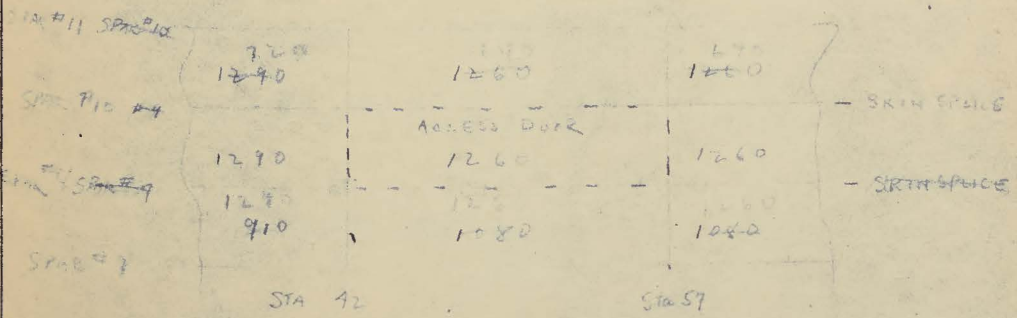
$$= -2010 \ \#/in$$

b) SHEAR FLOW AT CHORDWISE ATTACHMENT DUE TO TRANSFER OF 60% AXIAL LOAD THRU DOOR.

$$(1.2)\sigma_0 t = 18000(.155)(1.2) = 3350 \ \#/in$$

c) SHEAR FLOW IN PANELS DUE TO FIN BENDING & TORSION

VALUES OF q_s (REF)



AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/05-3/8
SHEET NO 5-37

AIRCRAFT:		PREPARED BY	DATE
C-105	FIN. ACCESS DOOR (LIMITER)	L. MATALON	4-4-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT-OUT (CONT'D.)

THE MAXIMUM SHEAR FLOW AT THE RIB OF THE DISCONTINUOUS PANEL DUE TO TRANSFER OF 50% OF THE AXIAL LOAD THRU THE DOUBLER IS MODIFIED TO TAKE INTO CONSIDERATION THE CONTINUOUS STRINGER IN THE CENTER OF THE ACCESS DOOR.

IT IS ASSUMMED MODIFIED IN RATIO OF THE DOUBLER AREAS ON THE STRINGERS.

TOTAL DOUBLER AREAS = 6(.156) = .936 IN^2

DOUBLER AREA OF BORDER STRINGER = 2.5(.156) = .39 IN^2

DOUBLER AREA OF CENTER STRINGER = 1.0(.156) = .156 IN^2

MAXIMUM SHEAR FLOW @ THE RIB

a) @ THE BORDER OF CUT-OUT

$$q_{b_R} = 2\tau_{2R} t_2 \left(\frac{.39}{.936}\right) = 2(-2010)\left(\frac{.39}{.936}\right)$$

$$= -1680\ \#/IN$$

b) @ THE CENTER OF CUT-OUT

$$q_{c_R} = 2\tau_{2R} t_2 \left(\frac{.156}{.936}\right) = 2(-2010)\left(\frac{.156}{.936}\right)$$

$$= -670\ \#/IN.$$

ORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/0583/6
SHEET NO. 5-43

AIRCRAFT:		PREPARED BY	DATE
C-105	FIN ACCESS DOOR (LIMITER)	L. MATALON	4-4-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT OUT

SHEAR FLOW ALONG DISCONTINUOUS PANEL

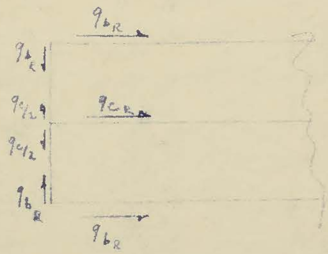
b) CHORDWISE RATE OF DECAY OF SHEAR FLOW

THE CHORDWISE SHEAR FLOW AT THE CUT-OUT ALONG THE DISCONTINUOUS PANEL HAS BEEN FOUND BY TEST RESULTS TO APPROXIMATE A CUBIC PARABOLA (REF.) VARYING FROM THE MAXIMUM AT THE BORDER OF THE CUT-OUT TO ZERO AT THE CENTER. HOWEVER IN ORDER TO TAKE INTO ACCOUNT THE CONTINUOUS STRINGER AT THE CENTER OF THE PANEL THE POINT OF ZERO SHEAR WILL FALL OTHER THAN AT THE CENTER OF THE PANEL.

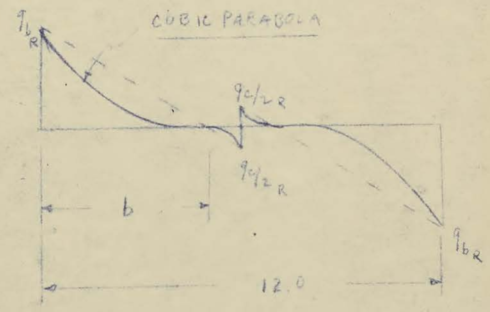
$q_{b_R} = -2920 \ \#/in$

$q_{c_R} = -1170 \ \#/in$

} REF Pg



$q_{c_{R/2}} = -585 \ \#/in$



CHORDWISE SHEAR FLOW

POINT OF ZERO SHEAR

$$\frac{2920+585}{6} = \frac{2920}{b}$$

$b = 5.0''$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (LIMITER)	REPORT NO. 7/0583/5	SHEET NO. 5.45
		PREPARED BY: L. MATALON	DATE: 4-4-55
		CHECKED BY:	DATE:

CHECK OF STRESSES AROUND CUT-OUT

SHEAR FLOW ALONG DISCONTINUOUS PANEL

b) CHORDWISE RATE OF DECAY OF SHEAR FLOW (CONT'D.)

THE RATE OF DECAY OF q_b ONLY WILL BE TABULATED.

$$q_{b_x} = q_{br}\left[1 - \frac{x}{b}\right]^3 \quad \text{(CUBIC PARABOLA)}$$

$$= -2920\left[1 - \frac{x}{5.0}\right]^3$$

(1)	(2)	(3)
x	$\left[1 - \frac{x}{5.0}\right]^3$	q_{b_x}
REF		-2920 (2)
0	1	-2920
1	.512	-1500
2	.216	-630
3	.064	-185
4	.008	-25
5	0	0

CHECK OF STRESSES AROUND CUT-OUT

RIVET ATTACHMENTS (CONT'D)

a) @ POINT ①

THERE IS A VARYING SHEAR FLOW OF q_{b_y} @ POINT ① WHICH REACHES A MAXIMUM OF 2920 #/IN AT THE CUT OUT.

$q_1 = q_{cR} = 2920$ #/IN (REF PG)

1/4" HI-SHEAR RIVETS @ 1.0" PITCH — NOW 2 ROWS I.E. BOTH SIDES OF ℄ CAP OF SPAR 8.

$P_{RIVET} = 2920$ #

$P_{ALLOWABLE} = 3680$ # (REF)

$MS = \frac{3680}{2920} - 1 = .26$ .26

b) @ POINT ②

THERE IS A VARYING SHEAR FLOW OF q_{c_y} @ POINT ② WHICH REACHES A MAXIMUM OF 1170 #/IN AT THE CUT-OUT.

$q_2 = q_{cR} = 1170$ #/IN (REF PG)

3/16 HI-SHEAR RIVETS @ 1.0" PITCH — NOW 1.02" PITCH

$P_{RIVET} = 1170$ #

$P_{ALLOWABLE} = 2120$ # (REF PG) $\times \frac{1.0}{1.2} = 1765$ #/"

$MS = \frac{1765}{1170} - 1 = .51$ (~~$\frac{2120}{1170} - 1 = .81$~~) .51 ~~.81~~

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT NO. 7/0583/4
		SHEET NO. 5-48
AIRCRAFT: C-105	FIN ACCESS DOOR (LIMITER)	PREPARED BY: L. MATALON — DATE: 4-4-55
		CHECKED BY: — DATE:

CHECK OF STRESSES AROUND CUT-OUT

RIVET ATTACHMENTS (CONT'D)

c) @ POINT ③

* THE PITCH OF THE 5/16 JO-BOLTS IS 1.0" OVER 4 PITCHES ADJACENT TO THE CORNER I.E. REGION OF MAX. CONCENTN. BEYOND THIS THE PITCH IS 1.25" APPX FOR 3 PITCHES — CONSIDERED REASONABLE

THERE IS A SPANWISE SKIN SPLICE @ POINT 3, THEREFORE IN ADDITION TO THE VARYING SHEAR FLOW q_{br}, THE SHEAR FLOW DUE TO FIN BENDING AND TORSION IS ALSO TRANSFERRED THRU THE RIVETS.

$$q_3 = q_{br} + q_s = 2920 + 1290 \quad (\text{REF PGS \_})$$

$$= 4210 \ \#/\text{IN}$$

FLEXURAL LOAD ... 300LB/IN (APPROX)

5/16 HI-SHEAR RIVETS @ 1.0" PITCH — LOAD = 4210 + 300 ≈ 4230 LB

$$P_{RIVET} = 4230 \#$$

*

$$P_{ALLOWABLE} = 5000 \ \#/\text{IN} \ (\text{REF} \quad)$$

BEARING OF ... BOLT IN SKIN COVERED

$$MS = \frac{5000}{4230} - 1 = .19$$ .19

d) @ POINT ④

THE CHORDWISE ATTACHMENT @ POINT 4 IN ADDITION TO TRANSFERING 60% OF THE AXIAL LOAD THRU THE ACCESS DOOR ALSO TRANSFERS THE SHEAR FLOW DUE TO FIN BENDING AND TORSION AND† HALF THE SHEAR FLOW DUE TO TRANSFER OF 50% OF AXIAL LOAD THRU THE DOUBLER.

$$q_4 = \sqrt{(1.2\sigma_0 t)^2 + (q_s + q_{br}/2)^2}$$

$$= \sqrt{(3350)^2 + \left(1290 + \frac{2920}{2}\right)^2}$$

$$= 4330 \ \#/\text{IN}$$

† THIS ASSUMES BOTH SKIN AND DOUBLER SHARE THE CHORDWISE SHEAR FLOW DUE TO DIFFUSION, THE SKIN COULD TAKE MORE THAN THIS ASSUMED 50% I.E. BOLT LOAD IS PROBABLY CONSERVATIVE.

FORM 1719A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (LIMITER)	REPORT NO. 7/0583/8	SHEET NO. 5-42
		PREPARED BY: L. MATALON	DATE: 4-14-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT-OUT

RIVET ATTACHMENTS

d) @ POINT (B) (CONT'D)

1/4" ~~LOCK BOLTS~~ JO-BOLTS (STEEL) @ 1.0" PITCH

3 PITCHES SLIGHTLY < 1.0
APP.x 5 PITCHES SLIGHTLY > 1.0 i.e. 1.02".

SHEAR ALLOWABLE = 4650# (REF=   )

BEARING ALLOWABLE

ON .155" THICK 75 ST-6 ALCLAD

$P_{br_{ALL}} = 141000(.25)(.155) = 5450\#$

$MS = \frac{4650}{4330} - 1 = .07$ .07

FORM 1319A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (LIMITER)	REPORT NO. 7/0583/18	SHEET NO. 15-50
		PREPARED BY: L. MATALON	DATE: 4-4-55
		CHECKED BY:	DATE:

CHECK OF STRESSES AROUND CUT-OUT

RIVET ATTACHMENTS (CONT'D)

e) @ POINT (5)

THE CHORDWISE ATTACHMENT @ POINT 5 TRANSFERS 60% OF THE AXIAL LOAD THRU THE ACCESS DOOR PLUS THE SHEAR FLOW DUE TO FIN BENDING & TORSION.

$$q_5 = \sqrt{(1.2\,\sigma_s t)^2 + q_s^2} = \sqrt{(3350)^2 + (1260)^2}$$

$$= 3570 \ \#/\text{in}$$

$$\text{LOAD} = 3570 \times 12 = 42900 \ \#$$

* (10) 1/4" NAS KAYLOCKS & (1) 3/16 AN KAYLOCK

ALLOWABLE 1/4 NAS KAYLOCK = 4650# (REF PG)

ALLOWABLE 3/16 AN KAYLOCK = 2070# (REF)

TOTAL ALLOWABLE = 10(4650) + 2070 = 48570#

?

$$M.S. = \frac{48570}{42900} - 1 = .13$$

(.13)

* ASSUMING 11 × 1/4" NAS KAYLOCKS (INCLUDES ONE ON EACH SPAR CAP) + 1 × 3/16" NAS KAYLOCK

BEARING STRENGTH IN .156" THICK DOOR

$$= (11 \times 3900) + 2620 = 42900 + 2620$$

$$= 45{,}520 \ \#.$$

$$M.S. = \frac{45520}{42900} - 1 = .055$$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN · ACCESS DOOR (LIMITER)	REPORT NO 7/0583/18	SHEET NO 5-51
		PREPARED BY: L. MATALON	DATE: 4-5-55
		CHECKED BY:	DATE:

CHECK OF STRESSES AROUND CUT-OUT

RIVET ATTACHMENTS (CONT'D)

f) @ POINT 6

THE SHEAR LOAD DUE TO FIN BENDING & TORSION IS ASSUMED 100% EFFECTIVE IN TRANSFER THRU THE ACCESS DOOR

$q_s = 1260$ #/IN

RIB-WISE LOADING = 200 lb/in (APPROX) RESULTANT LOAD = 200 + 1260 = 1330 LB

1/4" NAS KAYLOCKS @ 1.0" PITCH ✓

SHEAR ALLOWABLE = 4650 #/IN (REF)

BEARING ALLOWABLE = 3900 #/"

MS = LARGE

POINT 8

SHEAR LOAD = 1260 LB/IN

RIBWISE LOAD = 300 LB/IN

RESULTANT LOAD = 1330 LB/IN

ATTACHMENT:

1/4" STEEL [illegible] AT 1.00 IN PITCH ✓

= 9650 LB/IN

MS LARGE

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT No. 7/0588/3 SHEET No. 5-52	
AIRCRAFT: C.105	FIN ACCESS DOOR (LIMITER)	PREPARED BY L. MATALON (COPIED)	DATE 3-55-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUTOUT,

RIVET ATTACHMENTS (CONT'D)

9) @ POINT 7

THE TRANSFER OF LOAD THROUGH THE RIVET ATTACHMENT @ POINT 7 IS NEGLIGABLE.

3/16" NAS KAYLOCKS @ 1" PITCH.

$q_{ALL} = 2070$ #/IN.

M.S. = LARGE.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	7/0583/8
SHEET No.	5-53.
PREPARED BY	J.D.O'D.
DATE	18-11-55
CHECKED BY	
DATE	

AIRCRAFT: C.105.

FIN.
ACCESS DOOR (LIMITED)

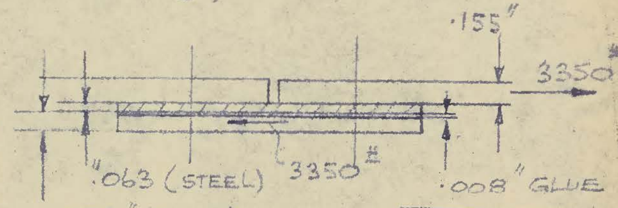
CHORDWISE SPLICE PLATE.

STEEL STRIP .063"
DRG. 7-0583-1571
MAT'L. MIL/S/5059 (HALF HARD)

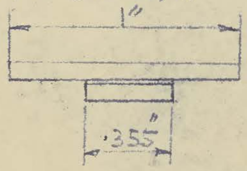
SPANWISE LOAD/IN = 3350 #/"
(SHT. 5-48, (d))

ASSUME EQUIV. WIDTH OF ALUMINUM IN STEEL

$= \frac{E_{AL.}}{E_{ST.}} = \frac{10.3}{29.0} \times 1 = .355''$



.073" (ALUM) *



* .156" - .083" = .073

$\bar{y} = \frac{(1 \times .063 \times .0315) + (.355 \times .073 \times .1075)}{.063 + (.355 \times .073)}$

$= \frac{.001984 + .002787}{.063 + .0259}$

$= \frac{.004771}{.0889} = \underline{.0537 \text{ INS.}}$

$I_{NA} = (.063 \times .0222^2) + (.0259 \times .0538^2) + \left(\frac{1 \times .063^3}{12}\right) + \left(\frac{.355 \times .073^3}{12}\right)$

$= .00003103 + .000075 + .00002085 + .00003240$

$= .00015928 \text{ INS}^4.$

$Z_{TOP\ OF\ STEEL} = \frac{.00015928}{.0537} = .00296 \text{ INS}^3.$

$Z_{BTM\ OF\ ALUM.} = \frac{.00015928}{.0903} = .001764 \text{ INS}^3.$

OFFSET FROM N.A = .0725 + .0537 = .1262 INS.

∴ M = 3350 × .1262 = 422.5 IN. LB.

∴ f_{max} IN STEEL $= \frac{3350}{.0889} + \frac{422.5}{.00296}$

$= 37700 + 142800 = 180,500$ P.S.I.

$R_{BENDING} = \frac{142,800}{220,000} = .65$

$R_{END\ LOAD} = \frac{37,700}{...} = .252$

$M.S = \frac{1}{.65 + .252} - 1 = \frac{1}{.902} - 1$

.11

A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7/0583/8	SHEET No. 5 - 54	
AIRCRAFT: C. 105.	FIN. ACCESS DOOR (LIMITER)	PREPARED BY J.A.O'B & D.S. DATE 17-11-55 / CHECKED BY DATE

$$f_{BTM.} \text{ IN ALUM} = \left(37700 - \frac{422.5}{.001764}\right)\frac{10.3}{29.0}$$

$$= \left(37{,}700 - 239{,}500\right)\frac{10.3}{29.0}$$

$$= -201{,}800 \times \frac{10.3}{29.0} \quad = -71{,}700 \text{ P.S.I.}$$

FOR 75 ST. 6. $(.04 < t < .5)$ $M.S = \frac{77{,}000}{71{,}700} - 1$ | .073 NO SHEAR

ON THE ABOVE SECTION THERE IS ALSO APPLIED A S.P.I OF 1290 #/" FROM FIN BENDING AND TORSION.

$$\therefore \tau_s = \frac{1290}{.0889} = 14{,}500 \text{ P.S.I.}$$

$$\therefore \tau_A = 14{,}500 \times \frac{10.3}{29.0} = 5{,}150 \text{ P.S.I.}$$

$$\therefore R_s \text{ IN STEEL} = \frac{14{,}500}{80{,}000} = .181.$$

$$\therefore R_s \text{ IN ALUM} = \frac{5{,}150}{46{,}000} = .112.$$

$\therefore$ NET MARGIN ON STEEL.

$$M.S = \frac{1}{.252 + \sqrt{.65^2 + .181^2}} - 1 = \frac{1}{.927} - 1 = .080$$

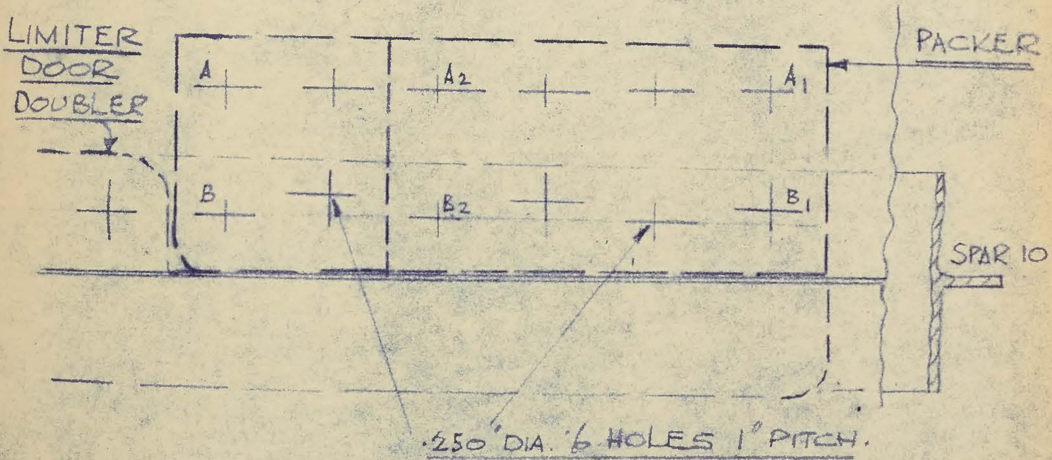
$\therefore$ NET MARGIN ON ALUM.

$$M.S = \frac{1}{\sqrt{\left(\frac{71700}{77000}\right)^2 + (.112)^2}} - 1 = \frac{1}{.938} - 1 = .066$$

FORM 1319A

PACKER - DOUBLER. DRG. 7-1083-989

FOR EASE OF ASSEMBLY OF SUB-ASSEMBLY FOR'D. OF SPAR 10 TO SPAR 10 THE DOUBLER IS CUT BACK TO THE ℄ OF SPAR 10 CAP ABOVE ACCESS DOOR. THE LEVELS ARE MAINTAINED BY THIS PACKER ATTACHED TO THE SKIN OF THE SUB-ASSEMBLY FOR'D. OF SPAR 10.



THE ATTACHMENTS OF THE PACKER TO THE SKIN ($A - A_1$) WILL BE MADE UP TO THE LOAD PUT INTO THE PACKER BY THE SKIN ATTACHMENTS TO THE SPAR CAP ($B - B_1$)

BOTH ROWS OF ATTACHMENTS ARE 1/4" DIA (I.E. $A - A_1$ ARE HI-SHEAR RIVETS, $B - B_1$ ARE NAS. SCREWS) AND THE THICKNESSES FOR BEARING ARE EQUAL.

1/4" HI-SHEAR RIVET S. SHEAR STRENGTH = 3680 #.
1/4 NAS SCREW S. SHEAR STRENGTH = 4650 #.

A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7/0583/B, VOL.2
SHEET No. 5-54 (B).

AIRCRAFT:		PREPARED BY	DATE
C. 105.	ACCESS DOOR (LIMITER)	J. D. DOHERTY.	
		CHECKED BY	DATE

THICKNESS OF 75 ST PLATE TO EQUAL S. SHEAR STRENGTH OF NAS SCREW = ·132 INS

(I.E BEARING STRENGTH = $3290 \times 1\cdot 37 \times \frac{1\cdot 32}{1\cdot 28} = 4650$ #)

THIS THICKNESS OCCURS AT BOLT B_2.

∴ OVER RANGE $B_2 - B_1$ & $A_2 - A_1$ STRENGTHS ARE EQUAL.

∴ OVER RANGE $B - B_2$ & $A - A_2$ STRENGTH OF PACKER ATTACHMENT IS SLIGHTLY DOWN

$$\text{MARGIN} = \frac{3680}{4650} - 1 = -\cdot 21$$

THIS IS ACCEPTED DUE TO DOUBTFUL KNOWLEDGE OF LOAD ON SKIN JOINT SCREWS.

FORM 1319A

AVRO AIRCRAFT LIMITED

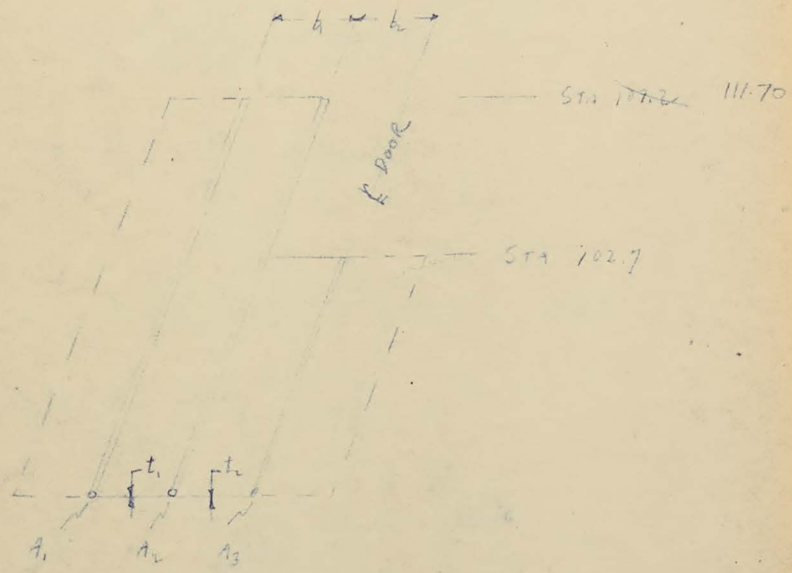
TECHNICAL DEPARTMENT (Aircraft)

REPORT No	7/0583/18
SHEET No	5-56
PREPARED BY	DATE
L. MATALON	4-11-55
CHECKED BY	DATE

AIRCRAFT:	
C-105	FIN ACCESS DOOR (WAVE GUIDE)

CHECK OF STRESSES AROUND CUT-OUT (REF NACA ARR 3J02)

ASSUME THE ACCESS DOOR TO BE 50% EFFECTIVE IN TRANSMITTING AXIAL LOAD, THEREFORE 50% OF THE LOAD IS ASSUMED TO BE TRANSMITTED AROUND THE ACCESS DOOR THRU THE DOUBLER.



$A_1 = 1.622 \text{ in}^2$

$A_2 = .473 \text{ in}^2$

$A_3 = .345 \text{ in}^2$

$b_1 = 7.5 \text{ in}$

$b_2 = 2.5 \text{ in}$

$t_1 = t_2 = .138$

CHECK OF STRESSES AROUND CUT-OUT

SHEAR FLOW ALONG DISCONTINUOUS PANEL

a) SPANWISE RATE OF DECAY OF SHEAR FLOW (q_R)

$$q_y = q_R\, e^{-r_3 y} \quad (\text{REF} \quad).$$

$$\text{WHERE: } r_3 = -\frac{G\, \sigma_{2R}^{*}}{E b_2\, \tau_{2R}} = -\frac{3.9(10)^6\,(25100)}{10.3(10)^6\left(\frac{-990}{.138}\right)2.5}$$

$$= .529$$

$$\therefore \quad q_y = -990\, e^{-.529 y}$$

①	②	③	④
y REF	$e^{-.529y}$	q_y $-990 \times$ ②	Δ SHEAR q_y(AVERAGE) Δy
0	1	-990	-0
2	.347	-344	-1334
4	.120	-119	-463
6	.042	-42	-161
		Σ	-1958

* σ_{2R} WITHOUT DOUBLER (REF Pg)

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7/0583/8
SHEET No. 5-62

AIRCRAFT:		PREPARED BY	DATE
C-105	FIN ACCESS DOOR (WAVE GUIDE)	L. MATALON	4-12-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT-OUT

SHEAR FLOW ALONG DISCONTINUOUS PANEL

a) SPANWISE RATE OF DECAY OF SHEAR FLOW (CONT'D)

TOTAL LOAD PICKED UP BY BORDER DOUBLERS

$$P_1 = 2(1958) = 3916$$

SINCE IT IS ASSUMED THAT THE TOTAL LOAD GOING THRU THE DOUBLERS IS EQUAL TO 50% OF THE LOAD IN THE DISCONTINUOUS PANEL, THE SHEAR FLOW q_y ALONG THE DISCONTINUOUS PANEL IS CORRECTED SO AS TO TRANSFER THE LOAD

$$P_2 = \sigma_0 2 A_3 = 10500(2)(.345) = 7250^{\#}$$

$$\text{CORRECTION FACTOR "K"} = \frac{P_2}{P_1} = \frac{7250}{3916} = 1.85$$

$$q_{y\,CORR} = 1.85\, q_y$$

y REF	q_y P_G	$q_{y\,CORR}$ $1.85\,q_y$
0	-990	1830
2	-344	636
4	-119	220
6	-42	78

FORM 1319 A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (WAVE GUIDE)	REPORT NO. 2/0583/8	SHEET NO. 5-64
		PREPARED BY: L. MATALON	DATE: 4-12-55
		CHECKED BY:	DATE:

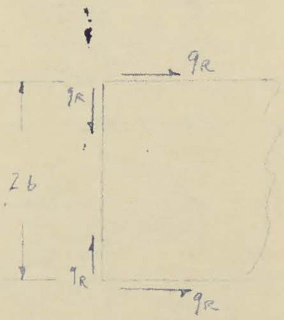
CHECK OF STRESSES AROUND CUT-OUT

SHEAR FLOW ALONG DISCONTINUOUS PANEL (CONT'D)

b) CHORDWISE RATE OF DECAY OF SHEAR FLOW (q_R)

THE CHORDWISE SHEAR FLOW AT THE CUT-OUT ALONG THE DISCONTINUOUS PANEL HAS BEEN FOUND BY TEST RESULTS TO APPROXIMATE A CUBIC PARABOLA VARYING FROM THE MAXIMUM AT THE BORDER OF THE CUT-OUT TO ZERO AT THE CENTER (REF)

$q_R = -1830$ #/in (REF PG)



$$q_x = q_R\left[1 - \frac{x}{b}\right]^3$$

$$= -1830\left[1 - \frac{x}{2.5}\right]^3$$

①	②	③
x	$\left[1 - \frac{x}{2.5}\right]^3$	q_x
REF		-1830 ②
0	1	-1830
.5	.511	-935
1.0	.216	-395
1.5	.064	-115
2.0	.008	-15
2.5	0	0

FORM 1319A

CHECK OF STRESSES AROUND CUT-OUT

CHECK OF ATTACHMENTS (CONT'D.)

b) @ POINT (2)

THERE IS A SPANWISE SKIN SPLICE @ POINT (2) ∴ THE RIVET ATTACHMENT TRANSMITS BOTH THE q_R DUE TO TRANSFER OF 50% OF THE AXIAL LOAD THRU THE STRINGER AND THE q_s DUE TO FIN BENDING & TORSION

$$q_2 = q_R + q_s = 1830 + 654 = 2484 \text{ \#/in}$$

CHORDWISE BENDING PUTS APPROX. 300 LB/IN END LOAD IN SKIN

RESULTANT APPROX LOAD = 2500 + 300 = 2630 LB/IN

1/4 HI-SHEAR RIVETS @ 1.0" PITCH — FORD SIDE — 1/4 30°

1/4 NAS SCREWS @ 1.0" PITCH — AFT SIDE

THICKNESS OF SKIN = .138" (REF P9)

$P_{ALLOWABLE}$ = 3400# (REF [illegible])

$$MS = \frac{3400}{2630} - 1 = .29$$

.29

c) @ POINT (3)

THE CHORDWISE ATTACHMENTS @ POINT (3) TRANSMIT 60% OF THE AXIAL LOAD THRU THE ACCESS DOOR PLUS THE SHEAR FLOW DUE TO FIN BENDING & TORSION AND HALF THE SHEAR FLOW DUE TO TRANSFER OF 50% OF THE AXIAL THRU THE STRINGERS.

$$q_3 = \sqrt{(1.2\sigma_0 t)^2 + (q_s + q_R/2)^2}$$

$$q_3 = \sqrt{(1740)^2 + (949 + 1830/2)^2} = 2560 \text{ \#/in}$$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ACCESS DOOR (WAVE GUIDE)	REPORT No. 7/0583/8	SHEET No. 5-68
		PREPARED BY: L. MATALON	DATE: 4-12-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT-OUT

CHECK OF ATTACHMENTS

c) @ POINT (3) (CONT'D)

1/4" HI-SHEARS @ 1.0" PITCH

ALLOWABLES

SHEAR ALLOWABLE = 3400# (REF PG)

BEARING ALLOWABLE ON .107" THICK DOUBLER 75ST-6

$= 141000(.107)(.25) = 3760\#$

$$MS = \frac{3400}{2560} - 1 = .33$$ .33

d) @ POINT (4)

THE CHORDWISE ATTACHMENTS @ POINT (4) TRANSMIT 60% OF THE AXIAL LOAD THRU THE ACCESS DOOR PLUS THE SHEAR DUE TO FIN BENDING & TORSION.

$$q_4 = \sqrt{(1.2\, \sigma_c t)^2 + q_s^2}$$

$$= \sqrt{(1740)^2 + (949)^2} = 1990\ \#/in$$

1/4 ~~AN-509~~ NAS. SCREWS @ 1.0" PITCH {MAX. PITCH SLIGHTLY > 1.0 · BUT AVE. PITCH < 1.0.

BEARING OF NAS SCREW IN .144 DOOR = 3660 #

$P_{all} = 2100(1.364) = 2860\#$ (Ref.)

$$MS = \frac{3660}{1990} - 1 = .84$$ (~~2860~~) .84 (44) (44)

1/4" NAS SCREWS AT 1.00" PITCH

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/0583/8	SHEET NO. 5-69	
AIRCRAFT: C-105	FIN ACCESS DOOR (WAVE GUIDE)	
PREPARED BY: L. MATALON	DATE: 4-12-55	
CHECKED BY:	DATE:	

CHECK OF STRESSES AROUND CUT-OUT

CHECK OF ATTACHMENTS (CONT'D)

e) @ POINT (5)

THE SHEAR LOAD DUE TO FIN BENDING & TORSION IS ASSUMED 100% EFFECTIVE IN TRANSFER THRU THE ACCESS DOOR

$q_s = 949 \ \#/in$

THERE IS ALSO APPROX. 800 LB/IN END LOAD DUE TO RIB BENDING

RESULTANT LOAD 800 ~~+~~ 949 = 1250 LB/IN.

1/4 ~~TH 809~~ SCREWS @ 1.5 PITCH NOW 1" PITCH

NAS.

$P_{ALL} =$ ~~2860~~ 3660 #/SCREW (REF PG 5-68)

$q_{ALL} = \frac{2860}{1.5} = 1900 \ \#/in$

$MS = \frac{3660 \ \cancel{1900}}{1250} - 1 = .52$

71.0

.52

AVRO AIRCRAFT LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT

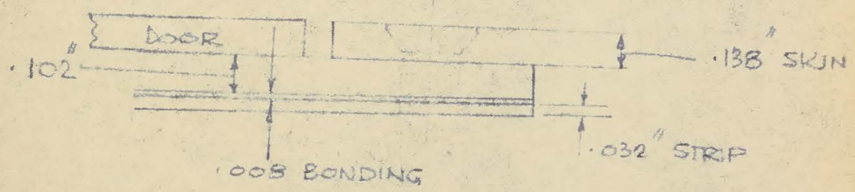
REPORT No. 7/0583/8	SHEET No. 5+71	
AIRCRAFT: C.105.	FIN. ACCESS DOOR WAVE GUIDE	PREPARED BY / DATE / CHECKED BY / DATE

ALSO τ_P = 36,650 psi.

cf. F_{SU} = 43,000 psi. ·17

CONSIDER STBD (I.E R.H) SIDE.

FOR ECONOMY OF MATERIAL BASIC DOUBLER IS ·102" THICK WITH A ·032 STRIP BONDED ON.



$$\bar{y} = \frac{(\cdot102 \times \cdot051) + (\cdot032 \times \cdot126)}{\cdot134} = \frac{\cdot0052 + \cdot0040}{\cdot134} = \cdot0687''$$

$$\therefore I_{NA} = (\cdot102 \times \cdot0177^2) + (\cdot032 \times \cdot0573^2) + \frac{\cdot102^3}{12} + \frac{\cdot032^3}{12}$$

$$= \cdot000032 + \cdot000105 + \cdot000088 + \cdot000003$$

$$= \cdot000228 \ IN^4/IN.$$

$$\therefore Z_{\text{TOP EDGE}} = \frac{\cdot000228}{\cdot0687} = \cdot00332 \ IN^3/IN$$

$\therefore$ AREA = A = ·102 + ·032 = ·134 IN^2/IN.

$\therefore$ ECCENTRICITY = ·069 + ·0687 = ·1377 IN.

$\therefore$ BM/IN = 1450 × ·1377 = 199.5 # IN/IN

$$\therefore f_T = \frac{1450}{\cdot134} + \frac{199.5}{\cdot00332} = 10,830 + 60,000$$

$$= \underline{70,830 \text{ psi.}}$$

COVERED ABOVE

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/0580/8		SHEET NO. 5-73	
AIRCRAFT: C-105	FIN — ACCESS DOOR (WAVE GUIDE)	PREPARED BY: L. MATALON	DATE: 5-5-55
		CHECKED BY:	DATE:

CHECK OF DOUBLER @ PT. 5

CHECK OF SECTION A-A (CONT'D)

$$\tau_{MAX} = \sqrt{\left(\frac{55500+7850+21000}{2}\right)^2 + (9300)^2}$$

$$= 43000 \text{ psi}$$

$F_t = 74000$ psi

$F_s = 44000$ psi

$$MS_t = \frac{74000}{65350} - 1 = .13 \qquad .13$$

$$MS_\tau = \frac{44000}{43000} - 1 = .02 \qquad .02$$

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT No. 7/0583/18	
C-105	FIN ACCESS DOOR #2	SHEET No. 5-74	
		PREPARED BY	DATE
		L. MATALON	4-14-55
		CHECKED BY	DATE

CHANGE IN MOMENT OF INERTIA

I (WITH NO CUT-OUT) = 45.9 IN⁴ (REF

ACCESS DOOR

50% I = .50 (.127 × .50)(2.04)² = 1.32 IN⁴

DOUBLER

Changed to .081 ✓

.072" THICK × 2.5" WIDE ON SPAR #3 & 1.8" WIDE ON SPAR #4

$I = 2.5(.072)(1.9)^2 + 1.8(.072)(2.0)^2 = 1.17 \text{ IN}^4$

I (WITH CUT-OUT) = 45.9 − 1.32 + 1.17 = 45.75 IN⁴

$\text{RATIO} = \frac{45.75}{45.9} = 99.8\%$

FORM 1119A

CHECK OF STRESSES AROUND CUT-OUT (CONT'D)

MAXIMUM SHEAR FLOW IN DISCONTINUOUS PANEL

a) @ RIB DUE TO TRANSFER OF 50% AXIAL LOAD THRU DOUBLER

$$q_R = \tau_{2R} t = -\sigma A_2 \frac{K_4}{D}\left(1 + P C_0 + \frac{L}{K}\right)$$

$$= -5770(.445)\frac{.0431}{.444}\left[1 + (.63)(.305) + \frac{.01865}{.0367}\right]$$

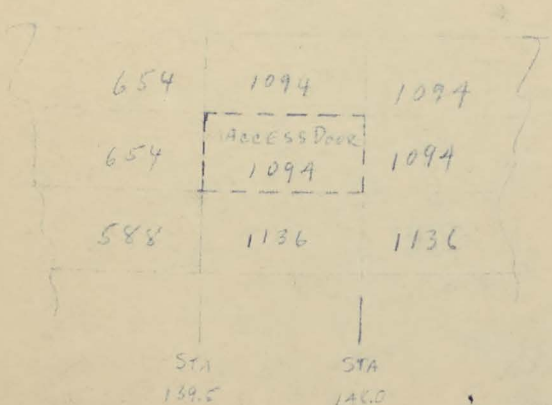
$$= -423 \text{ \#/IN}$$

b) SHEAR FLOW @ CHORDWISE ATTACHMENT DUE TO TRANSFER OF 60% AXIAL LOAD THRU ACCESS DOOR

$$1.2\,\sigma_0 t = 1.2(5000)(.127) = 761 \text{ \#/IN}$$

c) SHEAR FLOWS IN PANELS DUE TO FIN BENDING & TORSION

VALUES OF q_s



AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT No. 7/0583/18	
CF105	FIN ACCESS DOOR #2	SHEET No. 5.89	
		PREPARED BY	DATE
		L. MATALON	4-15-55
		CHECKED BY	DATE

CHECK OF STRESSES AROUND CUT-OUT

CHECK OF ATTACHMENTS (CONT'D)

e) @ POINT (5)

THE SHEAR LOAD DUE TO FIN BENDING & TORSION IS ASSUMED 100% EFFECTIVE IN TRANSFER THRU ACCESS DOOR.

$q_s = 1094$ #/IN

RIB-WISE ENDLOAD = 1000 lb/in, RESULTANT LOAD = 1000 + 1094 = 1460 lb/in

1/4 NAS ? SCREWS @ 1.00" PITCH

CRITICAL IN BEARING ON ~~.072~~ .091 DOUBLER

$P_{ALL} = 141000(.25)(.~~072~~) = 2540$ # — ? .091 = 3210

BEARING OF 1/4" C'SK. SCREW IN .127 skin = 3250 #

$MS = \frac{~~2540~~\ 3210}{1460} - 1.00$ 1.2 ~~.74~~

f) @ POINT (6)

SAME LOAD AS POINT (5)

3/16 ~~STEEL Jo BOLTS~~ HI-SHEARS @ 1.00" PITCH

SINGLE SHEAR = 2620 LB

CRITICAL IN BEARING ON ~~.072~~ .091 DOUBLER

$P_{ALL} = 141000(.1875)(.072) = 1900$ #
BEARING

P_{ALL} S.SHEAR = 2120

$MS = \frac{~~1900~~\ 2120}{1460} - 1 = ~~.30~~\ .47$ .47 ~~.30~~

FORM 1319A

LOADS

$$f_{xx\,(AXIAL)} = \frac{64500}{23.5}(1.75) = 4800 \text{ psi}$$ (REF REPORT # 7/0583/9 Pg 11)

$$f_{zz\,(CHORDWISE)} = 4800 \text{ psi}$$ (ASSUMED)

$$q = 563 \text{ \#/in}$$ (REF REPORT # 7/0583/3B)

$$f_s = \frac{563}{.125} = 4500 \text{ psi}$$

CHECK OF STRESSES AROUND CUT-OUT

SINCE THE ANTENNA ACCESS DOOR IS SIMILAR TO THE #2 ACCESS DOOR, STRUCTURALLY, AND HAS MUCH SMALLER LOADS IMPOSED ON IT, NO FURTHER ANALYSIS IS NECESSARY.

CHECK STRESS CONCENTRATION AROUND HOLE (REF. R & M #1834)

THERE IS A 1.81 DIAMETER HOLE IN THE ACCESS DOOR SLIGHTLY REINFORCED BY THE ANTENNA SUPPORT. HOWEVER SINCE THE ANTENNA SUPPORT IS OF 3S ALUMINUM IT WILL BE NEGLECTED AS FAR AS REINFORCING THE HOLE IS CONCERNED.

a) DUE TO SHEAR

CIRCUMFERENTIAL STRESS $= 4.0 f_s = 4(4500) = 18000$ psi

RADIAL STRESS $= .2 f_s = .2(4500) = 900$ psi

SHEAR STRESS $= 1.4 f_s = 1.4(4500) = 6300$ psi

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/[illegible]3/8 SHEET No 5-92	
AIRCRAFT: C-105	FIN ACCESS DOOR (ANTENNA)	PREPARED BY L. MATALON	DATE 7-13-[illegible]
		CHECKED BY	DATE

CHECK STRESS CONCENTRATION AROUND HOLE (CONT'D)

b) DUE TO TENSION

CIRCUMFERENTIAL STRESS = $3.0 f_{tx} = 3.0(4800) = 14400$ psi

RADIAL STRESS = $.3 f_{tx} = .3(4800) = 1440$ psi

SHEAR STRESS = $1.4 f_{tx} = 1.4(4800) = 67[illegible]0$ psi

THE CIRCUMFERENTIAL & RADIAL STRESS FOR THE SHEAR & TENSION LOAD ACT AT POINTS 90° APART, HOWEVER CONSERVATIVELY ADDING THEM DIRECTLY —

TOTAL CIRCUMFERENTIAL STRESS = 32400 psi (CONSERVATIVE)

TOTAL SHEAR STRESS = 13000 psi

$F_{tu} = 77000$ psi
$F_s = 43000$ psi
} REF ANC-5

MS = LARGE

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	7/0583/8
SHEET NO.	5-34
PREPARED BY	L. MATALON
DATE	7-15-55
CHECKED BY	
DATE	

AIRCRAFT. C-105

FIN
ACCESS DOOR (LIMITER)

STRINGER & SKIN SECTION PROPERTIES (CONT'D)

b) @ POST SPACING OF 10.6"

DUE TO THE PILOT FEEL DEVICE THE NORMAL POST SPACING OF 5.3" IN THIS AREA IS INCREASED TO 10.6". IN ORDER TO MAINTAIN THE SAME L/ρ VALUE OF THE SKIN & STRINGER COMBINATION AS THAT WITH A POST SPACING OF 5.3 INCHES A STIFFENER IS ADDED TO THE BASIC SECTION AS SHOW BY THE DOTTED LINES ON PG — .

ITEM	A	y	Ay	Ay²	Io
1-4	1.0503		.1469	.06407	.0088
5	.0745	1.229	.0915	.11213	.0053
6	.0880	1.315	.1155	.15200	—
7	.0137	1.190	.0163	.01940	—
	1.22265		.3702	.34760	.0141

$$\bar{y} = \frac{.3702}{1.2265} = .302$$

$$I = .3476 + .0141 - .302(.3702) = .249$$

$$\rho = \sqrt{\frac{.249}{1.2265}} = .450$$

$$\frac{L}{\rho} = \frac{10.6}{.45} = 23.6$$ (CHECKS WITH L/ρ = 23.8 @ POST SPACING OF 5.3".)

FORM 1719A

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/058/8 SHEET No. 6-1	
AIRCRAFT: C-105	FIN SPARS	PREPARED BY L. MATALON	DATE 6-10-55
		CHECKED BY	DATE

METHOD OF ANALYSIS

THE WEBS WILL BE ANALYZED FOR SHEAR RESISTANCE UP TO LIMIT LOAD USING THE FULL MOMENT & SHEAR FLOW & THEN AS A SEMI-TENSION FIELD WEB USING THE ULTIMATE SHEAR FLOW & ONLY THE LIMIT BENDING MOMENT. (AS PER [illegible] WITH MR [illegible] & MR DOUGHERTY 6-8-55)

THE WEB ATTACHMENTS TO THE SPAR CAPS ARE ANALYZED FOR SEMI TENSION FIELD LOADS USING THE ABOVE COMBINATION OF ULTIMATE SHEAR FLOW COUPLED WITH LIMIT BENDING.

FORM 171PA

TABULATED SPAR SHEAR FLOWS*

HINGE ℄ STATION	SHEAR FLOW (#/IN)					
	SPAR #14	SPAR #10	SPAR #7	SPAR #5	SPAR #3	SPAR #1
ROOT TO -23.0	670	1180	—	—	—	—
-23.0 TO 6.0	320	1340	1770	—	2500	—
6.0 TO 24.0	560	780	1340	—	2500	3220
24.0 TO 42.0	—	620	1140	—	1680	2290
42.0 TO 67.0	—	500	1240	643	1420	2680
67.0 TO 92.0	—	700	1020	590	1400	1120
92.0 TO 112.0	—	—	1080	—	2450	990
112.0 TO 137.0	—	—	950	—	1970	750
137.0 TO TIP	—	—	840	—	1200	1926

* THE MOST CRITICAL OF THE SPAR SHEAR FLOWS OF THE REPORTS LISTED BELOW ARE USED.

1) 7/0583/10 Pg 136

2) 7/0583/3B Pgs 3-60 & 5-67

3) 7/0583/2B Pg 3-47

FORM 1319A

A. V.

AIRC
WEIG
C. G.

CHECK OF WEB

SPAR #14

HINGE ℄ STATION	1 WEB THICKNESS t	2 SECTION HEIGHT ℄ SKIN LINE h	3 WEB HEIGHT @ RIVET LINE h'	4 STIFFENER SPACING d	5 BENDING a/b	6 BENDING K	7 BENDING F_{bcr}	8 SHEAR a'/b'	9 SHEAR K'	10 F_{scr}
REF			② -1.8		④/③	[illegible]	⑥ $E\left(\frac{①}{③}\right)^2$	[illegible]	[illegible]	[illegible] $\frac{t}{b'}$
-59.0 TO -54.0	.064	8.5	6.7	5.0	.75	21.6	20300	1.34	7.4	11300
-28.0 TO -23.0	.064	7.2	5.4	5.0	.93	21.6	31100	1.08	8.2	12500
-23.0 TO -18.0	.064	7.0	5.2	5.0	.96	21.6	33700	1.04	8.5	1360[illegible]
6.0 TO 16.0	.064	5.2	3.4	∞	∞	21.6	74100	∞	5.35	17700
SPAR #10										
-42.0 TO -38.0	.072	8.7	6.9	4.0	.58	21.9	24500	1.72	6.9	20900
-27.0 TO -23.0	.072	8.5	6.7	4.0	.60	21.8	26000	1.68	6.9	20400
-23.0 TO -19.0	.072	8.2	6.4	4.0	.63	21.6	28200	1.60	7.0	21200
2.0 TO 6.0	.072	7.5	5.7	4.0	.70	21.6	35200	1.43	7.3	22000
6.0 TO 10.0	.072	7.3	5.5	4.0	.73	21.6	38100	1.38	7.4	[illegible]
20.0 TO 24.0	.072	6.8	5.0	4.0	.80	21.6	46000	1.25	7.6	[illegible]
24.0 TO 42.0	.072	6.5	4.7	∞	∞	21.6	52100	∞	5.35	11[illegible]
42.0 TO 67.0	.072	5.1	3.8	∞	∞	21.6	74000	∞	5.[illegible]	[illegible]
67.0 TO 92.0	.072	4.2	2.4	∞	∞	21.6	74000	∞	5.35	[illegible]000

FORM 1543

A. V. ROE CANADA LIMITED
MALTON, ONTARIO
TECHNICAL DEPT. (AIRFRAME)

AIRCRAFT - - C-105
WEIGHT - -
C. G. POSITION -

REPORT NO. - [illegible]
SHEET - - 6-3
DATE - - 6-10-55
PREPARED BY - L. MATALON

9	10	11	12	13	14	15	16	17	18	19
SHEAR									WEB BUCKLING	
K'	F_{SCR}	f_b (ULTIMATE) @ SKIN LINE	f_b (LIMIT) @ RIVET LINE	f_s (ULTIMATE)	f_s (LIMIT)	R_b (LIMIT)	R_s (LIMIT)	R_s (ULTIMATE)	M.S. (LIMIT LOAD)	M.S. (ULT. SHEAR & LIMIT BEND.)
[illegible]	(9) 4.33 $(\frac{t}{b})^2$ × 10^6		⑪ ③ / ② 1.364			⑫ / ⑦	⑭ / ⑩	⑬ / ⑩		
7.4	11300	18500	10700	10500	7700	.527	.681	.928	.16	-.12
8.2	12500	31000	17100	10500	7710	.550	.616	.840	.21	-.01
8.5	13000	31700	18300	5080	3720	.542	.286	.391	.63	.50
5.25	17700	31000	14000	8750	6400	.200	.361	.495	>1.0	.87
6.9	20900	27000	15700	16300	11900	.640	.570	.780	.16	-.01
6.9	20900	33000	19100	16300	11900	.735	.570	.780	.07	-.07
7.0	21200	34000	19400	18600	13600	.689	.641	.879	.06	-.10
7.3	22000	41000	22900	18600	13600	.650	.618	.845	.11	-.06
7.4	[illegible]	40600	22400	10800	7900	.589	.353	.482	.45	.31
7.1	[illegible]	38500	20700	10800	7900	.450	.343	.470	.76	.54
5.35	11900	36000	19100	8600	6300	.366	.538	.735	.53	.22
5.2	[illegible]	30000	14900	6950	5100	.201	.283	.386	>1.0	>1.0
5.35	[illegible]	22000	9200	9750	7150	.124	.163	.222	>1.0	>1.0

A. V

AIRC

WEI

C. C

CHECK OF WEB

SPAR #3

HINGE ℄ STATION	1 WEB THICKNESS t	2 SECTION HEIGHT @ SKIN LINE h	3 WEB HEIGHT @ RIVET LINE h'	4 STIFFENER SPACING d	5 BENDING a/b	6 K	7 F_{bcr}	8 SHEAR a'/t	9 K'	10 $F_{s\,cr}$
			② - 1.6		④/③	[illegible]	⑥ E (①/③)^2	[illegible]		⑨ 9.35 [illegible]
-4.7 TO 6.0	.091	6.6	5.0	5.0	1.00	21.6	74000	1.00	8.8	2720
6.0 TO 11.0	.091	6.4	4.8	5.0	1.04	21.6	74000	1.04	8.5	285
19.0 TO 24.0	.091	6.2	4.6	5.0	1.09	21.6	74000	1.09	8.3	3030
24.0 TO 42.0	.091	6.0	4.4	∞	∞	21.6	74000	∞	5.25	2040
42.0 TO 67.0	.091	5.7	4.1	∞	∞	21.6	74000	∞	5.35	2460
67.0 TO 92.0	.091	5.2	3.6	∞	∞	21.6	74000	∞	5.35	319
92.0 TO 112.0	.091	4.7	3.1	∞	∞	21.6	74000	[illegible]	5.35	45
112.0 TO 137.0	.091	4.4	2.8	∞	∞	21.6	74000	∞	5.35	15
137.0 TO TIP					MS = 7 1.0					

FORM 1543

A. V. ROE CANADA LIMITED

MALTON, ONTARIO

TECHNICAL DEPT. (AIRFRAME)

AIRCRAFT - [illegible]

WEIGHT -

C. G. POSITION -

REPORT NO. - [illegible]

SHEET - 6-5

DATE - 6-15-55

PREPARED BY -

8	9	10	11	12	13	14	15	16	17	18	19
SHEAR										WEB BUCKLING	
a'/t	K'	$F_{S\,CR}$	f_b (ULTIMATE) @ SKIN LINE	f_b (LIMIT) @ RIVET LINE	f_s (ULTIMATE)	f_s (LIMIT)	R_b (LIMIT)	R_s (LIMIT)	R_s (ULTIMATE)	M.S. (LIMIT LOAD)	M.S. (ULT. SHEAR & LIMIT BEND.)
[illegible]	[illegible]	[illegible]									
1.00	8.8	27200	47000	26000	27400	20100	.351	.740	1.010	.22	-.07
[illegible]04	8.5	28500	43000	23600	27400	20100	.319	.705	.960	.29	-.01
[illegible]09	8.3	30300	37500	20400	27400	20100	.276	.664	.905	.39	.06
[illegible]	5.35	20400	33700	18500	18500	13600	.250	.664	.906	.41	.06
[illegible]	5.35	24600	30200	16000	15600	11500	.216	.465	.635	.94	.48
[illegible]	5.35	31900	25400	12900	15400	11300	.175	.354	.482	71.0	.91
[illegible]	5.35	45000	21000	10200	26900	19700	.138	.457	.625	71.0	.56
[illegible]	5.35	45000	15000	9000	21700	15900	.095	.370	.505	71.0	.95

A. V. R…

AIRCRAF…

WEIGHT …

C. G. P…

CHECK OF WEB

SPAR #1

HINGE ℄ STATION	1 WEB THICKNESS t	2 SECTION HEIGHT @ SKIN LINE h	3 WEB HEIGHT @ RIVET LINE h'	4 STIFFENER SPACING d	5 BENDING a/b	6 BENDING K	7 BENDING $F_{b\,cr}$	8 SHEAR a/b'	9 SHEAR K'	10 $F_{s\,cr}$
			② − 1.8		④/3		⑥$E\left(\frac{①}{③}\right)^2$		B	$\left(9.33\,\frac{t}{\ldots}\right)^2$
6.0 TO 24.0	.156	5.64	3.84	∞	∞	21.6	74000	∞	5.35	13000
24.0 TO 42.0	.156	5.40	3.60	∞	∞	21.6	74000	∞	5.35	13000
42.0 TO 67.0	.125	4.40	3.10	∞	∞	21.6	74000	∞	5.35	13000
67.0 TO 92.0	.125	4.40	2.60	∞	∞	21.6	74000	∞	5.35	13000
92 TO TIP			MS > 1.0							

SPAR #5 (WEB OF SPAR #5 EXTENDS FROM STA 42.0 TO 92.0)

HINGE ℄ STATION	t	h	h'	d	a/b	K	$F_{b\,cr}$	a/b'	K'	$F_{s\,cr}$
42.0 TO 67.0	.072	6.0	4.2	∞	∞	21.6	65400	∞	5.35	14700
67.0 TO 92.0	.072	5.6	3.8	∞	∞	21.6	74000	∞	5.35	18000

FORM 1543

A. V. ROE CANADA LIMITED
MALTON, ONTARIO
TECHNICAL DEPT. (AIRFRAME)

AIRCRAFT: C-105
WEIGHT:
C. G. POSITION:

REPORT NO.: 7/[illegible]/8
SHEET: 6-6
DATE: 6-16-55
PREPARED BY:

8	9	10	11	12	13	14	15	16	17	18	19
SHEAR										WEB BUCKLING	
a/b'	K'	$F_{s\,cr.}$	f_b (ULTIMATE) @ SKINLINE	f_b (LIMIT) @ RIVET LINE	f_s (ULTIMATE)	f_s (LIMIT)	R_b (LIMIT)	R_s (LIMIT)	R_s (ULTIMATE)	MS (LIMIT LOAD)	MS (RIVET SHEAR LIMIT BEND)
[illegible]	B	$(.933\ t/[illegible])^2$									
∞	5.35	13000	45500	22700	21700	15200	.307	.353	.481	71.0	.75
∞	5.35	13000	30000	14700	14600	10700	.199	.249	.340	71.0	71.0
∞	5.35	13000	25500	11900	21400	15700	.161	.365	.499	71.0	.91
∞	5.35	13000	22000	9500	9000	61[illegible]	.124	.155	.210	71.0	71.0
92.0)											
∞	5.35	14700	32000	16400	8930	6550	.251	.446	.607	.95	.52
∞	5.35	18000	26500	13200	8200	6000	.178	.334	.456	71.0	71.0

CHECK OF WEB ATTACHMENTS TO SPAR CAP

a) SPAR #14 (STA. -58.0 TO -54.0)

$q = 670 \ \#/\text{IN}$

$q_{cr} = \sqrt{1-(R_b)^2}\,(F_{0cr})t$

$= \sqrt{1-(.527)^2}\,(11300)(.064)$

$= 615 \ \#/\text{IN}$

$q_{tf} = q - q_{cr} = 670 - 615 = 55 \ \#/\text{IN}$

$q_{TOTAL} = \sqrt{q^2 + (q_{tf} \tan\alpha)^2}$

ASSUME $\alpha = 45^0$

$q_{TOTAL} = \sqrt{670^2 + 55^2} = 675 \ \#/\text{IN}$

3/16 HI-SHEARS @ 1.0" PITCH

SHEAR ALLOWABLE = 2070 #

BEARING ALLOWABLE = 137000(.1875)(.064) = 1640 #

MS = LARGE

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No 7/0583/18			
SHEET No 6-10			
AIRCRAFT: C-105	FIN SPARS	PREPARED BY: L. MATALON	DATE: 6-19-55
		CHECKED BY	DATE

CHECK OF WEB ATTACHMENTS TO SPAR CAP

c) SPAR #7 (CONT'D)

2) STA. 112.0 TO 137.0

$q = 950$ #/IN

$q_{tf} = 0$

3/16" HI-SHEARS @ 1.0" PITCH ✓

SHEAR ALLOWABLE = 2070 #

BEARING ALLOWABLE = 137000 (.1875)(.091) = 2330 #

MS = LARGE

d) SPAR #5 (STA 42.0 TO 67.0)

$q = 643$ #/IN

$q_{tf} = 0$

1/4" AD RIVETS @ 1.0" PITCH

RIVET ALLOWABLE = .980 (1550) = 1520 #

MS = LARGE

FORM 1318A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7/0583/8
SHEET NO. 6-11

AIRCRAFT:		PREPARED BY	DATE
C-105	FIN SPARS	L. MATALON	6-13-55
		CHECKED BY	DATE

CHECK OF WEB ATTACHMENTS TO SPAR CAP

e) SPAR #3

1) STA. -4.7 TO 6.0

$$q = 2500\ \#/in$$

$$q_{CR} = \sqrt{1 - R_b^2}\ (F_{SCR})(t)$$

$$= \sqrt{1 - .351^2}\ (27200)(.091)$$

$$= 2320\ \#/in$$

$$q_{tf} = q - q_{CR} = 2500 - 2320 = 180\ \#$$

$$q_{total} = \sqrt{q^2 + (q_{tf} \tan\alpha)^2} \quad \text{ASSUME } \alpha = 45^\circ$$

$$q_{total} = \sqrt{2500^2 + 180^2} = 2505\ \#/in$$

1/4" HI-SHEARS @ 1.0" PITCH

SHEAR ALLOWABLE = 3680 #

BEARING ALLOWABLE = 137000 (.25)(.091) = 3120 #

$$M.S. = \frac{3120}{2505} - 1 = .24$$

FORM 1318A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	7-0583-8
SHEET No.	6-14
PREPARED BY	DATE
L. MATALON	7-5-55
CHECKED BY	DATE

AIRCRAFT: C-105

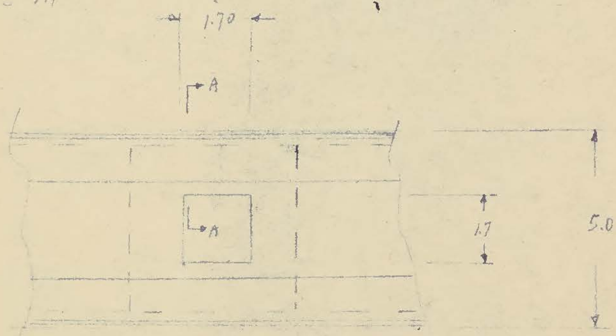
FIN SPARS

CHECK OF WEB CUT-OUT IN SPAR #7 @ STA 101.5

$V = 1080 (5.0) = 5400^{\#}$

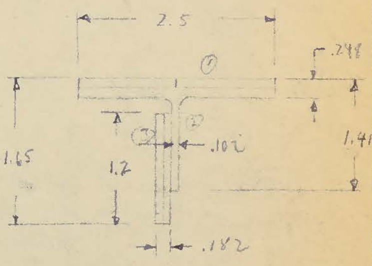
$M_{FIN} = 595000^{"\#}$

$I_{FIN} = 86.5 \text{ in}^4$



CHECK OF SECTION A-A

ITEM	A	y	Ay	Ay²	I₀
1	.620	.124	.0769	.00953	.00317
2	.119	.822	.0979	.08050	.01325
3	.218	1.050	.2285	.24000	.02623
Σ	.957		.4033	.33003	.04265



SECTION A-A

$\bar{y} = \frac{.4033}{.957} = .42 \text{ in}$

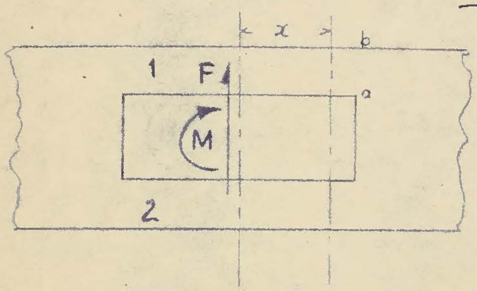
$I = .373 - .42(.4033) = .204 \text{ in}^4$

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0583-8			
SHEET No. 6-16			
AIRCRAFT: C105	FIN CUT OUT IN SPAR #3 AT STA 86.4	PREPARED BY: J.L. DIXON	DATE: 16 MAY 1955
		CHECKED BY	DATE

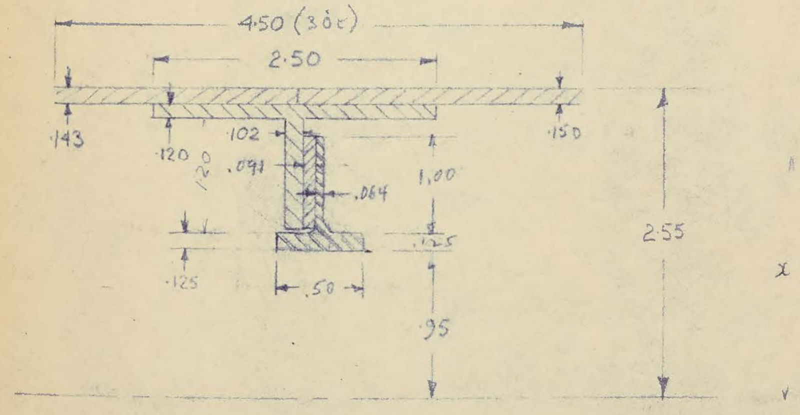
DRG. No. 7-1083-557.



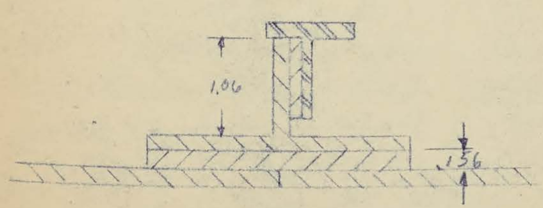
MAX. BENDING STRESS OCCURS AT a OR b.

$$= \frac{My}{I} + \frac{Fx\left[I_1/(I_1+I_2)\right]}{(I_1/c_1)}$$

SECTION ON STARBOARD SIDE (1) REF DWG # 7-0183-148



SECTION ON PORT SIDE



ALL OTHER DIMENSIONS SIMILAR TO STARBOARD SIDE.

MATERIAL - 75ST-6 ALCLAD EXCEPT FOR "TEE DOUBLER" WHICH IS 180000 HT STEEL

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	7-0583-8
SHEET NO.	6-18

AIRCRAFT:		PREPARED BY	DATE
C-105	FIN CUT OUT IN SPAR #3 @ STA 86.4	L. MATALON	6-22-55
		CHECKED BY	DATE

LOADS

$q = 1453\ \#/\text{IN}$ (REF. [illegible] 10 P. [illegible])

SHEAR $= 1453(5.01) = 7290\ \#$ (ULTIMATE)

FIN BENDING MOMENT $= .81(1.364)10^6 = 1.108 \times 10^6$ IN-LBS (ULTIMATE)

FIN MOMENT OF INERTIA $= 111.0\ \text{IN}^4$ (REF. REPORT 70583-20)

STRESS ON PT. "b" (STARBOARD SIDE)

$$f_{cut} = \frac{1.108 \times 10^6 (2.55)}{111.0} + \frac{7290(4.78 - .88)\left[.446/.446 + .449\right]}{.446/.491}$$

$$* = 25400 + 15600 = 41000 \text{ psi}$$

STRESS ON PT. "a" (STARBOARD SIDE)

$$f_{cut} = \left[\frac{1.108 \times 10^6 (.95)}{111.0} + \frac{7290(3.9)(.499)}{.446/1.109}\right] \frac{E_{STEEL}}{E_{ALUM.}}$$

$$= \left[9500 + 35200\right] \frac{29.0}{10.3} = 126000 \text{ psi}$$

DOUBLER FLANGE.

$$I = \frac{.125 \times .5^3}{12} = .00125$$

$$A = .125 \times .5 = .0625$$

$$e = \sqrt{I/A} = \sqrt{\frac{.00125}{.0625}} = \sqrt{.2} = .447.$$

$$\therefore \ell/e = \frac{10}{.447} = 22.$$

$* f \sim 25400$ psi

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:	FIN	REPORT No. 7-0583-8	
C-105	CUT-OUT IN SPAR #3 @ STA 86.4	SHEET No. 6-19	
		PREPARED BY	DATE
		L. MATALON	6-22-55
		CHECKED BY	DATE

STRESS ON PT "b" (PORT SIDE)

$$f_{c\,att} = \frac{1.108\times10^6(2.55)}{111.0} + \frac{7290(3.9)\left[.447/.446+.449\right]}{.449/.459}$$

$$= 25400 + 14600 = 40000 \text{ psi}$$

STRESS ON PT "a" (PORT SIDE)

$$f_{c\,att} = \left[\frac{1.108\times10^6(.95)}{111.0} + \frac{7290(3.9)(.501)}{.449/1.141}\right]\frac{E_{STEEL}}{E_{ALUM}}$$

$$= \left[9500 + 36200\right]\frac{29.0}{10.3} = 129000 \text{ psi}$$

CHECK CRIPPLING OF THE EFFECTIVE SKIN (WEB).

$f_c = 41000$ psi (REF PG)

CONSIDER THE SKIN AS FIXED AT THE RIVET AND HAVING THE OTHER EDGE FREE,

$F_{CR} = 49000$ psi (REF.)

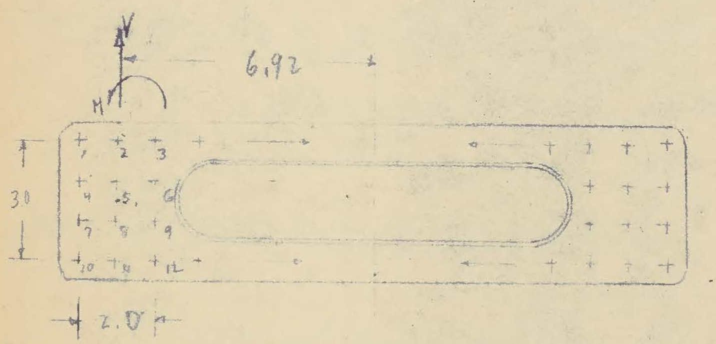
$$MS = \frac{49000}{41000} - 1 = .19$$

FORM 7119A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0583-2			
SHEET No. 6-24			
AIRCRAFT: C-105	FIN CUT-OUT IN SPAR #3 @ STA 86.4	PREPARED BY: L. MATALON	DATE: 5-30-55
		CHECKED BY	DATE

CHECK OF DOUBLER ATTACHMENTS. DRG. No 7-1083-557.



$V = 1453(5.01) = 7300\ \#$

$M = 7300(6.92) = 50600\ ''\#$

ASSUME THAT 75% OF THE SHEAR & MOMENT IS CARRIED BY THE DOUBLER.

1/4" STEEL HUCK L'BOLTS, THE #3 & #12 SCREWS ARE THE MOST HIGHLY LOADED.

$I_o = 4(1.0^2+1.5^2)\ 4(1.0^2+.5^2)+2(1.5^2+.5^2) = 23.0$

$P_V = \frac{7300(.75)}{12} + \frac{50600(.75)(1.00)}{23.0} = 2110\ \#$

$P_H = \frac{50600(.75)(1.5)}{23.0} = 2480\ \#$

$P_{total} = \sqrt{2480^2+2110^2} = 3260\ \#$

SHEAR ALLOWABLE = 4650 # (REF)

FORM 1319A

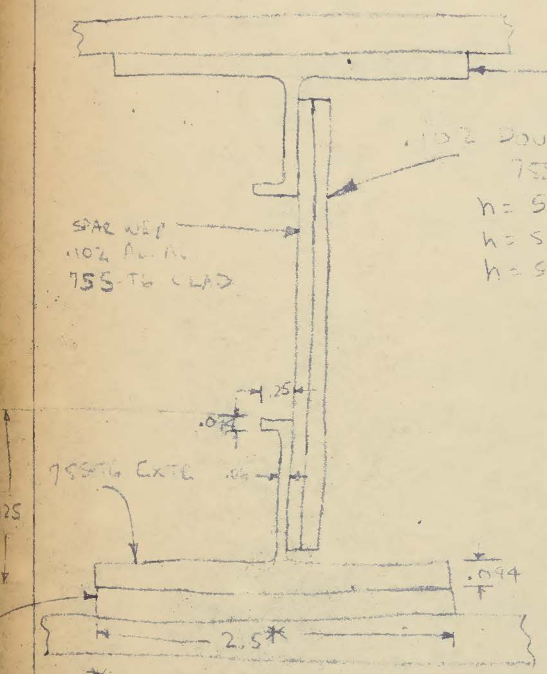
AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	SPAR #5 STA. 23.0	REPORT No 7/0583/8.	SHEET No 6-28
		PREPARED BY: R MELVILLE	DATE: 8 JUNE 1955
		CHECKED BY:	DATE:

SHEAR FLOW ON 2 HOLE PANEL AT ℄ HOLES = 600 #/IN h = 6.44 3860#

SHEAR FLOW ON 3 HOLE PANEL AT ℄ LARGE HOLE = 620 #/IN h = 6.35" 3940#

" " " 1 " " " HOLE = 642 #/IN h = 6.2" 4000#



75S-T6* CLAD ACCESS DOOR DOUBLER

.102 DOUBLER AREA PLUS SPAR WEB AREA WITHOUT HOLES

h = 5.5 @ 2 HOLE — $5.5 \times .204 = 1.12\ IN^2$

h = 5.4 @ 3 HOLE — $5.4 \times .204 = 1.10\ IN^2$

h = 5.25 @ 1 HOLE — $5.25 \times .204 = 1.07\ IN^2$

AREA OF ACCESS DOOR DOUBLER

$2.5'' \times .156'' = .39\ IN^2$

AREA OF ONE CAP $= (.094)(2.5) + (.06)(.937) + (.094)(.25) = .235 + .0561 + .0235$

$= .3146\ IN^2$

(1) AT TWO HOLE SECTION: TOTAL AREA $= .39 + 2(.3146) + 1.12 - 2(1.25)(.204)$

$= 1.6292 \cong 1.63\ IN^2$

$f = \frac{P}{A} = \frac{3860^{\#}}{1.63\ IN^2} = 2360$ PSI

USING JUST THE WEB & .102 DOUBLER AREA.

$f = \frac{P}{A} = \frac{3860^{\#}}{.61\ IN^2} = 6330$ PSI $M.S. = \frac{43000}{6330} - 1 = 5.80$

(2) AT THREE HOLE SECTION: USING JUST THE WEB & .102 DOUBLER AREA
(AND GREATLY ENLARGED HOLE) $A = (5.40'' - 2.84'')(.204\ IN) = .521\ IN^2$

$f = \frac{P}{A} = \frac{3940^{\#}}{.521\ IN^2} = 7520$ PSI $M.S. = \frac{43000}{7520} - 1 = 4.70$

(3) AT ONE HOLE SECTION: USING JUST THE WEB & .102 DOUBLER AREA

$A = (5.25 - 2.00)(.204) = .661\ IN^2$

$f = \frac{P}{A} = \frac{4000^{\#}}{.661\ IN^2} = 6030$ PSI $M.S. = \frac{43000}{6030} - 1 = 6.10$

TOTAL $A = .661 + .39 + 2(.3146) = 1.68\ IN^2$ $f = \frac{4000^{\#}}{1.68\ IN^2} = 2390$ PSI

FORM 1319A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft).

AIRCRAFT: C-105	SPAR #5 STA 23.0	REPORT No 7/0588/8	
		SHEET No 6 - 27	
		PREPARED BY: R MELVILLE	DATE: 8 JUNE 1955
		CHECKED BY	DATE

APPROX CHECK OF COLLAPSING SHEAR FOR HOLES.
FROM AVRO REP. GEN/1090/323 FOR HOLES FAR APART OR SINGLE LIGHTENING HOLES, THE FLANGE YIELD FORMULA IS

$$\tau_{av} = \frac{1}{4}\left(1 + 3.461\,\frac{h}{r}\right)\sigma_y \qquad \text{WHERE } \sigma_y = F_{cy}$$

FOR A NON-FLANGED HOLE $h = 0$

$$\therefore \tau_{av} = \frac{1}{4}\sigma_y$$

FOR .102 75S-T6 CLAD SHEET $\sigma_y = 64000$ PSI

$$\therefore \tau_{av} = \frac{64000}{4} = 16000 \text{ PSI}$$

BY USING THE CORRECTED FORMULA AND GRAPHS

$$\tau_y = \sigma_y\, Y\left[\left(\cos^{-1}\frac{r}{a}\right), \left(\frac{2h}{r}\left\{\frac{1-\cos\delta}{\sin\delta}\right\}\right)\right]$$

HERE $H = 0$ AND $\delta = 90°$

$$\therefore \tau_y = \sigma_y\, Y\left[\left(\cos^{-1}\frac{r}{a}\right), 0\right]$$

FOR THE 2-HOLE SECTION $\cos^{-1}\frac{.625}{1.21} = 58.9°$

$Y(58.9°) = .190 \qquad \sigma_y(.190) = 12200$ PSI $\qquad 12,200 \times .78 = 9500$

$M.S. = \frac{9500}{6330} - 1 = .50$

FOR THE 3 HOLE SECTION $\cos^{-1}\frac{.812}{1.606} = 59.5°$

$Y(59.5°) = .192 \qquad \sigma_y(.192) = 12300$ PSI $\qquad 12300 \times .78 = 9600$

$M.S. = \frac{9600}{7520} - 1 = .26$

FOR THE 1-HOLE SECTION $\cos^{-1}\frac{1.0}{1.25} = 37°$

$Y(37°) = .077 \qquad \sigma_y(.077) = 4940$ PSI $\qquad 4940 \times .78 = 3850$

$M.S. = \frac{3850}{2390} - 1 = .61$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	SPAR #5 STA 23.0	REPORT NO. 7/0583/8	SHEET NO 6-29
		PREPARED BY R. MELVILLE	DATE 8 JUNE 1955
		CHECKED BY	DATE

THE STIFFENER (OR POST) RIVETS ARE SPACED AT 1.1 INCHES.
THEY ARE AN 470 AD8 BRG ON .051 75S-T6 CLAD POSTS

S.S. = 1550 X .964 = 1500#

BRG. = 1310 X 1.37 = 1790#

$$ALLOW = \frac{1510\#}{1.1 \text{ IN}} = 1360\ \#/\text{IN} \qquad M.S. = \frac{1360\#/\text{IN}}{643\#/\text{IN}} = 1.11$$

RIVETS CONNECTING WEB AND DOUBLER TO THE EXTRUDED ANGLE ARE THE SAME AS ABOVE, BEARING IN THICKER MAT'L.

FORM 1103

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7/0583/8	SHEET No. 6-30	
AIRCRAFT: C-105	SPAR #5 STA 23.0	
PREPARED BY: R MELVILLE	DATE: 16 JUNE 1955	
CHECKED BY:	DATE:	

PROPOSED: .072 WEB WITH A LIGHTER FLANGED HOLE DOUBLER.

TWO-HOLE PANEL:

NET SHEAR AREA OF .072 WEB PLUS .040 DOUBLER =

$$[5.5\text{ IN} - 2(1.25)]\,[.072 + .040] = .391\text{ IN}^2$$

$$f = \frac{P}{A} = \frac{3860^{\#}}{.391\text{ IN}^2} = 9900^{\#}/_{IN^2}$$

$$M.S. = \frac{43000\text{ PSI}}{9900\text{ PSI}} - 1 = 3.35$$

FOR THE FLANGED HOLE: $r = .625$; $a = 1.21$; $h = .170$; $t = .040$; $\delta = 60°$; $r_f =$

FLANGE YIELDING STRESS:

$$\tau_y = \sigma_y\, Y\left[\left(\cos^{-1}\frac{r}{a}\right), \left(\frac{2h}{r}\left\{\frac{1-\cos\delta}{\sin\delta}\right\}\right)\right]$$

$$= \sigma_y\, Y\left[\left(\cos^{-1}\frac{.625}{1.21}\right), \left(\frac{2(.170)}{.625}(.579)\right)\right]$$

$$= \sigma_y\, Y[58.9°, .315]$$

$$= 37000 \quad (.310)$$ ASSUME 24S CLAD

$$\tau_y = 11450\text{ PSI}$$

ASSUME INTERACTION WITH FLANGE BUCKLING REDUCES τ_y TO 10,000 PSI.

~~THEN~~ $\tau_{ALLOW} = 10,000\text{ PSI} \times .78 = 7800\text{ PSI}$

IF AREA OF ONE CAP IS ADDED TO THAT OF WEB & DOUBLER (i.e. .3146 + .391) STRESS IS REDUCED TO ABOUT

$$f = \frac{P}{A} = \frac{3860^{\#}}{.706\text{ IN}^2} = 5500\text{ PSI}$$

FOR FLANGED HOLE $M.S. = \frac{7800\text{ PSI}}{5500\text{ PSI}} - 1 = .42$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	SPAR #5 STA. 23.0	REPORT NO. 7/0588/8	SHEET NO. 6-32
		PREPARED BY: R. MELVILLE	DATE: 17 JUNE 1955
		CHECKED BY:	DATE:

THREE HOLE PANEL (CONTINUED)

FLANGE BUCKLING STRESS:

$$\tau_{b1} = E \times 10^{-7} \left[\left(\frac{100t}{r}\right)^2 S\left(\cos^{-1}\frac{r}{a}\right) + \left(\frac{10h}{r}\right)^3 \left(\frac{.7071}{\sin 60^\circ}\right) F\left(\cos^{-1}\frac{r}{a}\right)\right]$$

$$= 1.05 \left[\left(\frac{100(.040)}{1.75}\right)^2 S(39.8^\circ) + \left(\frac{10(.240)}{1.75}\right)^3 (.818) F(39.8^\circ)\right]$$

$$= 1.05 \left[(5.23)(171) + (2.6)(.818)(2469)\right]$$

$$\tau_{b1} = 6410$$

SHEET BUCKLING STRESS:

$$\tau_{b2} = \frac{1550\ E \times 10^{-7}}{1 - \frac{r_c}{a}} \left(\frac{100t}{a}\right)^2$$

$$= \frac{1550(1.05)}{1 - \frac{1.889}{2.275}} \left(\frac{100(.040)}{2.275}\right)^2$$

$$\tau_{b2} = 29,600 \text{ PSI}$$

FROM P 5-6 OF REP. GEN/1090/323 THE CRITICAL INTERACTION IS:

$$\tau_{y+b1} = 4650 \text{ PSI}$$

$$\tau_{ALLOW} = 4650 \times .78 = 3625 \text{ PSI}$$

$$M.S. = \frac{3625 \text{ PSI}}{3200 \text{ PSI}} - 1 = .14$$

AVRO AIRCRAFT LIMITED TECHNICAL DEPARTMENT (Aircraft)		REPORT No. 7/[illegible]/[illegible] SHEET No. 7-2	
AIRCRAFT: C-105	FIN SPARS	PREPARED BY	DATE
		L. MATALON	6-7-55
		CHECKED BY	DATE

CHORDWISE STRESSES*

a) FROM MATRIX (REF. REPORT # 70583/3B VOL. II PGS 5-1 TO 5-67)

HINGE ℄ STATION	CHORDWISE STRESSES @ SPAR NOS. #1	#3	#5	#7	#10	#14	F/S
-23.0	—	—	—	-2208	+1473	+123	-354
6.0	-6780	-2730	—	-1010	-3070	-575	-364
21.0	-682	-3014	—	-3410	-723	—	+736
42.0	3070	123	1400	-736	+928	—	+1364

b) FROM ENGINEER BENDING (REF PG   )

HINGE ℄ STATION		#1	#3	#5	#7	#10	#14	F/S
67.0	FWD	1510	1900	1810	1520	930	—	497
	AFT	1510	1800	1810	1460	496	—	332
72.2	FWD	-3330	-1580	308	-652	—	—	427
	AFT	-3330	-1570	308	-620	—	—	165
112.2	FWD	3060	2670	—	1500	—	—	413
	AFT	3060	2540	—	1420	—	—	167
137.0	FWD	-910	-580	—	243	—	—	185
	AFT	-910	-553	—	234	—	—	80
TIP	FWD	-1050	360	—	7760	—	—	—
	AFT	-1050	341	—	7350	—	—	—

* THE CHORDWISE STRESSES AS TABULATED ABOVE ARE ON THE TENSION SIDE OF THE FIN WHERE -

1) NEGATIVE SIGN - CHORDWISE COMPRESSION

2) POSITIVE SIGN - CHORDWISE TENSION

FORM 1779A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO	7/05838/18
SHEET NO	7-4
AIRCRAFT:	C-105
	PANEL SHEARS FIN
PREPARED BY	L. MATALON
DATE	6-29-55
CHECKED BY	
DATE	

TABULATED SHEAR FLOWS (NO TENSION FIELD EFFECTS CONSIDERED)

PANEL #	q_{SHEAR}	$f_{CHORDWISE}$ Fwd	$f_{CHORDWISE}$ Aft	t	$q_{CHORDWISE}$ Fwd	$q_{CHORDWISE}$ Aft	q_{TOTAL} Fwd	q_{TOTAL} Aft
a	763	354	-123	.110	39	-14	764	763
b	961	-123	-1473	.115	-14	-169	961	976
c	1518	2208	2208	.183	404	404	1570	1570
d	146	369	575	.092	34	53	150	156
e	772	575	3040	.098	56	298	745	800
f	1339	3040	1010	.168	511	170	1430	1350
g	841	1010	2730	.174	176	475	861	966
h	764	2730	6780	.182	497	1230	910	1440
i	890	-736	3040	.092 / .098	-68	298	891	940
j	1220	3040	3410	.168 / .161	511	550	1320	1340
k	969	3410	3014	.168	572	506	1125	1090
l	1140	3014	6780	.175 / .182	526	1230	1255	1680
m	740	-1364	-928	.086	-117	-80	751	746
n	1290	-928	3410	.155 / .161	-143	550	1300	1400
o	1108	3410	3014	.168	572	506	1245	1215
p	1345	3014	-3070	.175 / .168	526	516	1445	1440
q	640	-1364	-928	.086	-118	-80	650	645
r	1260	-928	-1520	.155 / .145	-144	-220	1270	1280
s	1090	-1460	-1810	.152 / .152	-222	-275	1100	1110
t	1107	-1810	-1900	.152 / .152	-275	-289	1135	1140
u	880	-1800	-3070	.160 / .168	-289	-515	925	1015
v	330	-332	-930	.077	-26	-72	330	338
w	1003	-446	-1520	.145	-72	-220	1005	1025
x	1201	-1460	-1810	.152	-222	-275	1220	1230
y	945	-1800	3330	.160 / .150	-288	500	985	1070
z	583	-165	-1500	.136 / .129	-22	-193	583	615
a'	944	-1420	-2690	.136	-193	-363	966	1010
b'	826	-2540	3330	.143 / .150	-363	-500	836	966
c'	360	-167	-1500	.129	-22	-193	367	409
d'	654	-1420	-2070	.136	-193	-363	680	746
e'	588	-2540	-3060	.143	-363	-437	690	780
f'	303	—	-7760	.112	—	-851	—	903
g'	563	-9350	580	.119 / .127	-875	74	1030	566
h'	537	553	1050	.134 / .118	74	124	541	552

FORM 1718A

A. V. R

AIRCRAFT

WEIGHT

C. G. PO

PANEL BUCKLING (REF. NACA ARR L6A05)*

PANEL REF	1	2	3	4	5	6 CHORDWISE STRESS	7	8	9	10 AXIAL STRESS
	a	b	a/b	t	$(t/b)^2 \times 10^3$	σ_y psi	k_y	$k_{x_{CR}}$	$F_{b_{CR}}$ 9350 (5)(8)	f_b
a	40.0	7.50	6.67	.107	.203	-123	.065	3.97	7530	-21000
b	35.0	5.00	7.00	.119	.317	-1473	.284	3.86	19700	-29000
c	16.0	6.00	2.67	.191	.909	-1473	.104	3.67	31700	-30500
d	29.0	6.00	4.84	.094	.245	-123	.054	3.97	9100	-28000
e	29.0	5.00	5.80	.105	.441	-1473	[illegible]	3.58	14800	-33000
f	29.0	6.00	4.84	.173	.830	-1473	.190	3.86	30000	-35000
g	29.0	6.62	4.38	.179	.730	1010	-.146	4.15	28400	-35000
h	8.0	5.00	1.60	.365	5.340	2730	-.055	4.25	72000	-65000
i	18.0	5.00	3.60	.097	.376	-736	.210	3.78	13300	-32400
j	18.0	6.00	3.00	.165	.755	723	-.103	4.10	29000	-36000
k	18.0	6.62	2.72	.171	.666	1010	-.161	4.20	26200	-40000
l	18.0	5.00	3.60	.359	5.160	682	-.014	4.05	72000	-15000
m	18.0	4.50	4.00	.090	.400	-1364	.365	3.62	13500	-30000
n	18.0	6.00	3.00	.150	.625	-928	.159	3.88	22700	-36000
o	18.0	6.62	2.72	.164	.615	-1400	.244	3.76	21600	[illegible]

FORM 1543

A. V. ROE CANADA LIMITED
MALTON, ONTARIO
TECHNICAL DEPT. (AIRFRAME)

AIRCRAFT - - C-105
WEIGHT - -
C. G. POSITION -

REPORT NO. - 7/0553/[illegible]
SHEET - - 7-5
DATE - - [illegible]
PREPARED BY - L. MATALON

8	9	10	11	12	13	14	15	16	17	18	19
$k_{\tau CR}$	$F_{b\,CR}$ 7350 (5)(8)	AXIAL STRESS f_b	R_b	k_s	$F_{s\,CR}$ 7300 (5)(12)	f_s	R_s	M.S.			
3.97	7530	-21000	3.18	5.35	10150	7120	.700	-.69			
3.86	19700	-29000	1.47	5.35	27400	8200	.299	-.33			
3.87	31800	-30500	.93	6.23	43000	8370	.195	.05			
3.97	9100	-28000	3.08	5.35	12300	1550	.126	-.68			
3.58	14700	-33000	2.23	5.35	22100	7060	.320	-.56			
3.66	30000	-35000	1.17	5.35	41500	8000	.194	-.16			
4.15	28400	-35000	1.23	5.70	38500	4700	.122	-.19			
4.25	72000	-65000	.90	7.00	43000	3280	.076	.11			
3.78	13300	-32000	2.40	5.90	20800	9180	.441	-.59			
4.10	29000	-36000	1.24	6.10	43000	7400	.172	-.20			
4.20	26200	-40000	1.53	6.20	38600	5660	.147	-.35			
4.05	72000	-45000	.62	5.90	43000	3160	.074	.60			
3.62	13500	-30000	2.22	5.80	21700	8250	.380	-.56			
3.88	22700	-36000	1.59	6.10	35600	8600	.241	-.38			
3.76	21600	-36000	1.67	6.20	35700	6750	.189	-.41			

A. V

AIRC
WEIG
C. G.

PANEL BUCKLING (CONT'D.) (REF. NACA ARR L6 A05)*

	1	2	3	4	5	6	7	8	9	10
PANEL	a	b	a/b	t	$(t/b)^2 \times 10^3$	CHORDWISE STRESS f_y	k_y	$k_{x_{CR}}$	$F_{x_{CR}}$	AXIAL STRESS f_b
REF							-10×10^{-6} (6)/(5)	*	9350 (5)(8)	
p	18.0	5.00	3.60	.172	1.182	-3070	.278	3.70	40900	-34000
q	25.0	4.50	5.55	.083	.340	-1364	.443	3.68	11700	-30500
r	25.0	6.00	4.16	.150	.625	-1520	.260	3.75	20900	-34000
s	25.0	6.62	3.77	.156	.556	-1810	.348	3.63	18900	-34000
t	REF. REPORT # 7/05183/8 VOL. II (AILERON BOOK)									
u	16.8	5.00	3.36	.164	1.072	-3070	.306	3.72	37100	-30000
v	8.0	4.00	2.00	.075	.352	- 930	.253	3.76	12400	-23500
w	25.2	6.00	4.20	.141	.552	-1520	.294	3.70	19100	-28000
x	25.2	6.62	3.80	.147	.494	-1810	.392	3.60	16600	-28000
y	10.0	5.00	2.00	.155	.962	-1200	.200	3.80	34200	-25500
z	20.0	6.00	3.33	.134	.499	-1500	.321	3.60	16800	-22500
a'	20.0	6.62	3.02	.139	.441	-2670	.646	3.24	13300	22500
b'	20.0	5.00	4.00	.147	.863	-3060	.380	3.60	29100	-21000
c'	25.5	6.00	4.25	.125	.435	-1500	.369	3.65	14800	-16000
d'	25.5	6.62	3.85	.131	.392	-2670	.830	3.03	11100	16000

FORM 1843

A. V. RO

TEC

PANEL BUCKLING (CONTD) REF. NASA ARR L6A05

AIRCRAFT

WEIGHT

C. G. POSITI

PANEL REF.	1	2	3	4	5	6	7	8	9	10	11
	a	b	a/b	t	$(t/b)^2 \times 10^3$	CHORDWISE STRESS σ_y ⑥	k_y -1.07×10^{-4} ⑥/⑤	k_{xcr}	F_{bcr} 9350 ⑤⑧	AXIAL STRESS f_b	[illegible]
e'	25.5	5.0	5.10	.138	.761	-3060	.430	3.58	25500	15000	.5[illegible]
f'	12.0	5.0	2.40	.118	.556	-7760	1.492	<0	0	9000	0
g'	40.0	5.0	8.00	.120	.575	-7350	1.370	<0	0	4000	0
h'	40.0	5.0	8.00	.127	.645	-341	.057	3.97	23[illegible]	4000	.17

FORM 1543

A. V. ROE CANADA LIMITED MALTON, ONTARIO TECHNICAL DEPT. (AIRFRAME)	REPORT NO. - 7/[illegible]3/8
AIRCRAFT - - C-105 WEIGHT - - C. G. POSITION -	SHEET - - 7-7 DATE - - 7-6-55 PREPARED BY - L. MATA[illegible]

8	9	10	11	12	13	14	15	16	17	18	19
		AXIAL STRESS									
k_{tcr}	F_{bcr}	f_b	R_b	k_s	F_{scr}	f_s	R_s	MS			
	9350 (9)(8)				7350 (5)(12)						
3.58	25500	15000	.59	5.35	38200	4200	.111	.66			
<0	0	9000	∞	6.30	32800	2570	.081	neg[illegible]			
<0	0	4000	∞	5.35	26800	4700	.163	neg[illegible]			
3.77	23[illegible]	4000	.17	5.35	32200	4230	.131	>1.0			

AVRO AIRCRAFT LIMITED **TECHNICAL DEPARTMENT (Aircraft)**		REPORT No. 7/0583/8. SHEET No 7 – 8	
AIRCRAFT: C-105	FIN	PREPARED BY	DATE
		L. MATALON	5-6-55
		CHECKED BY	DATE

EVALUATION & USE OF TEST RESULTS ON FIN TEST BOX.

TESTS WERE RUN ON TWO FIN TEST BOXES, ONE WITH A SKIN THICKNESS OF .188" & THE OTHER WITH A SKIN THICKNESS OF .156". WITH THE MANY VARIABLE PARAMETERS, NO FAMILY OF CURVES CAN BE ESTABLISHED TO ENCOMPASS THE WHOLE FIN STRUCTURE HOWEVER A STRAIGHT LINE INTERPOLATION BETWEEN BOX FAILURE & THE SKIN THICKNESS OF THE TWO TEST BOXES WILL BE USED TO VALIDATE THE STRUCTURE. (AS PER DISCUSSION BETWEEN MR. MITCHELL & MR O'DOHERTY JUNE 3, 1955)

BOX # 4 (.188" SKIN - 4.0" POST SPACING)

$\sigma_{FAILURE} = 43000$ psi
$\tau_{FAILURE} = 9850$ psi
} (REF REPORT # 7/0583/1 Pg)

BOX # 5 (.156 SKIN - 5.3" POST SPACING)

$\sigma_{FAILURE} = 38100$ psi
$\tau_{FAILURE} = 12100$ psi
} (REF REPORT # 7/0583/1 Pg)

TEST RESULTS SHOW THAT DUE TO THE RATIO OF THE SHEAR & AXIAL LOADS THE SHEAR HAS VERY LITTLE EFFECT ON THE ULTIMATE FAILURE OF THE BOX & CONSEQUENTLY WILL BE NEGLECTED.

FORM 1319A