AVRO AIRCRAFT

TECHNICAL REPORT

J Thurston

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

ANALYZED

AIRCRAFT: C-105

REPORT No. 7/0562/9

FILE No.

No. OF SHEETS:

TITLE: WING CENTER BOX (FIN ATTACHMENT TO WING)

~~CONFIDENTIAL~~

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

PREPARED BY M.C.3456 — DATE
CHECKED BY DATE
SUPERVISED BY DATE
APPROVED BY DATE

ISSUE No.	REVISION No.	REVISED BY	APPROVED BY	DATE	REMARKS

FORM 1316A

15865813

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**	REPORT NO.	
	SHEET NO. .01	
AIRCRAFT: C-105	PREPARED BY	DATE
	McCABE	
	CHECKED BY	DATE

CONFIDENTIAL

TABLE OF CONTENTS

FORM 1319A

INTRODUCTION

THE PRINCIPAL FUNCTION OF THE FIN BOX STRUCTURE IS TO TRANSFER LOADS FROM THE FIN TO THE WING STRUCTURE

THE FINBOX IS A FABRICATED STRUCTURE MADE PRINCIPALLY OF 75S-T6 AL ALLOY. THE BASIC COMPONENTS THAT MAKE UP THE BOX ARE THE VERTICAL PLATES, HORIZONTAL PLATES, DIAPHRAGMS, AND LONGITUDINAL ANGLES.

VERTICAL COUPLE LOADS FROM THE FIN SKIN ARE CARRIED BY THE VERTICAL PLATES TO A SERIES OF DIAPHRAGMS SPACED AT VARYING INTERVALS ALONG THE BOX. THE DIAPHRAGMS THEN TRANSFER THE LOADS TO THE WING SKIN VIA THE HORIZONTAL PLATES. TORSIONAL SHEAR FROM THE FIN IS TRANSFERRED TO THE UPPER HORIZONTAL PLATES THROUGH THE LONGITUDINAL ANGLES ATTACHING TO THE PLATES & THE FIN SKIN.

FIN LOADS USED IN THE ANALYSIS ARE TAKEN FROM THE LOAD CURVE ON PG. 1.03. THE CURVE HAS BEEN MODIFIED TO ACCOUNT FOR THE REDISTRIBUTION OF LOAD IN THE REGION OF THE ELEVATOR JACK PANEL, SINCE THE PANEL IS NOT DESIGNED TO REACT END LOAD FROM THE HORIZ. PLATES.

THIS REPORT IS AN ANALYTICAL SUBSTANTIATION OF THE FIN BOX STRUCTURE & ATTACHMENTS.

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO.	
		SHEET NO. 1.01	
AIRCRAFT: C-105		PREPARED BY	DATE
		MCCABE	
		CHECKED BY	DATE

PART I ~ FIN BOX VERT. PLATES

FORM 1319A

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

REPORT No.		
SHEET No.	1.02	
AIRCRAFT: C-105	PREPARED BY	DATE
	McCABE	
	CHECKED BY	DATE

FIN BOX VERTICAL PLATES

DESCRIPTION

THE PRIMARY FUNCTION OF THE VERTICAL PLATES IS TO TRANSFER FIN SKIN END LOADS TO THE FIN BOX DIAPHRAGMS.

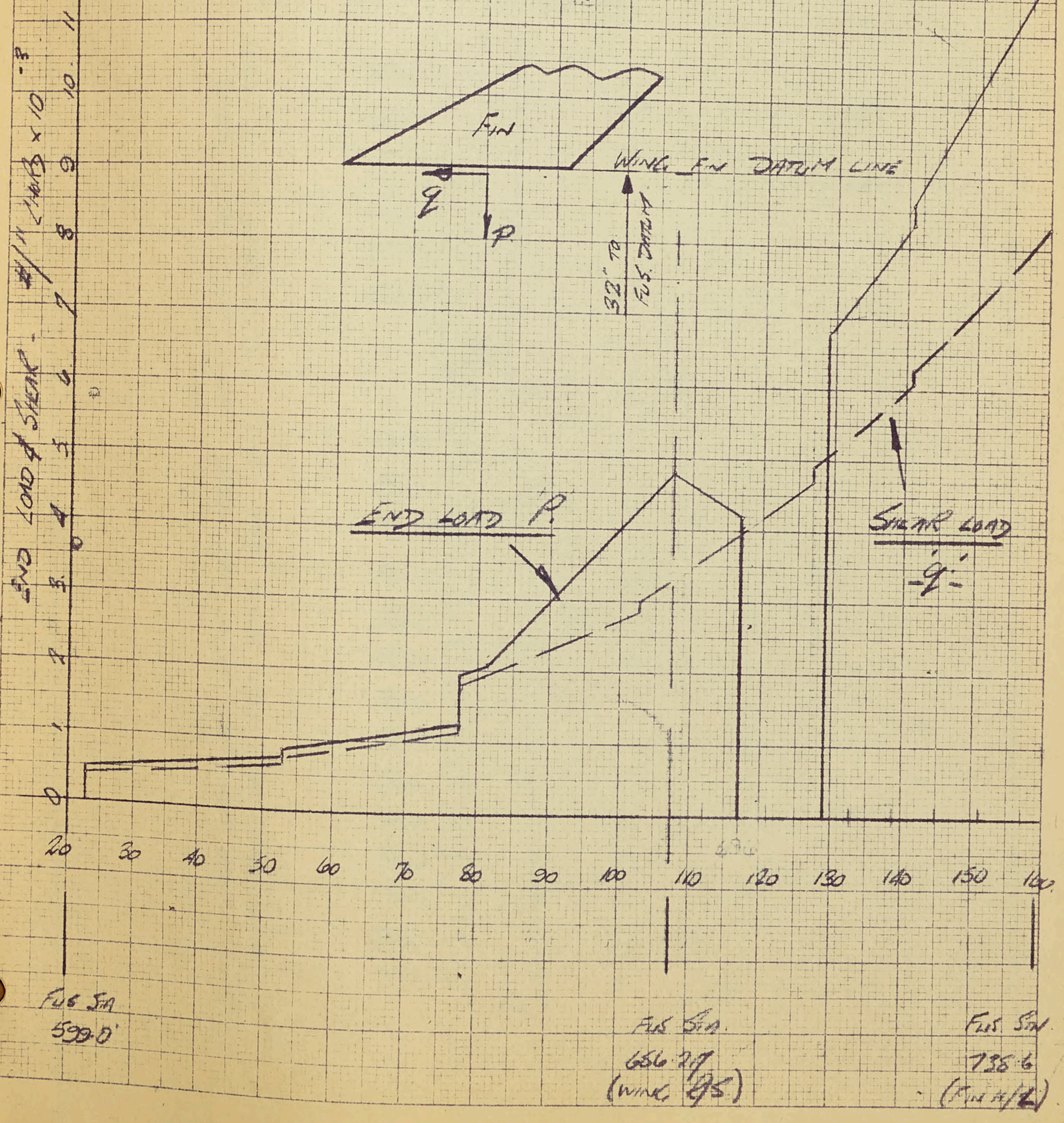
IN THE FOLLOWING ANALYSIS, EXCEPT FOR FINGER STRESSES, ONLY MOST CRITICAL PARTS & ATTACHMENTS ARE ANALYSED.

ADDITIONAL ANALYSIS OF DIAPHRAGM - PLATE ATTACHMENTS MAY BE FOUND IN "PART II".

FORM 1319A

℄105. Fin Root - Chordwise Distribution of End Loads and Shears - Ultimate End Loads for C.P. Aft Case

(Modified copy of curve received from H. Shotl 29.11.54)

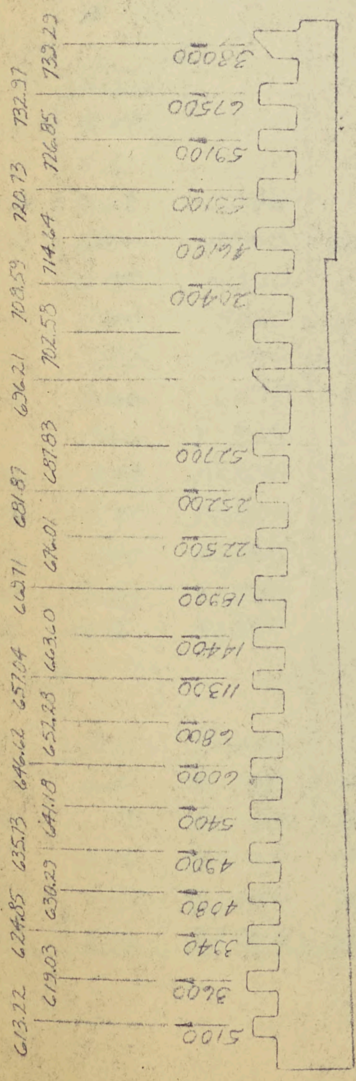


A. V. ROE CANADA LIMITED
MALTON, ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	
SHEET NO.	1.04
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	11-17-55
CHECKED BY	
DATE	

FIN BOX VERTICAL PLATES
FINGER LOADS - RPO CASE

REF. PG. 1.05 FOR LOADS



LOADS SHOWN ARE PER SIDE, AND MAY BE TENSION OR COMPRESSION.

FORM 1319A

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

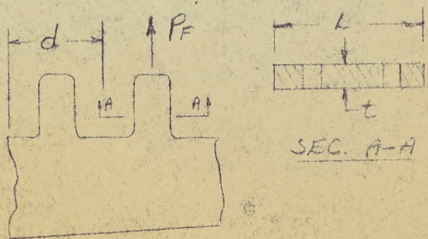
REPORT NO.	
SHEET NO.	1.05

PREPARED BY	DATE
McCABE	
CHECKED BY	DATE

AIRCRAFT: C-105

FIN BOX VERTICAL PLATES
FINGER LOADS & STRESSES

1	2	3	4	5	6	7	8
STA.	* p = FIN SKIN END LOAD	d	$P_F = p \cdot d$	t	L	A(COMP) $= t \cdot L$	A(TENS)
	REF PG. 1.03	DWG. NO. 7-0162-48		DRAWING NO. 7-0162-68			
613.22	600	8.49	5100	.114	2.3	.262	.177
619.03	620	5.81	3,600	.130	2.3	.299	.202
624.85	700	5.62	3940	.144	1.5	.216	.216
630.29	750	5.44	4080	.160	2.3	.368	.248
635.73	900	5.44	4900	.173	1.65	.286	.268
641.18	1,000	5.44	5440	.189	2.3	.435	.293
646.62	1,080	5.55	6,000	.201	1.65	.332	.312
652.28	1,200	5.66	6,800	.216	2.3	.497	.318
657.04	2,000	5.66	11,300	.228	1.55	.354	.334
663.60	2,450	5.88	14,400	.252	2.3	.580	.390
669.71	3,050	6.20	18,900	.261	2.5	.652	.456
67[illegible].01	3,700	6.08	22,500	.258	2.3	.594	.465
681.87	4,270	5.91	25,200	.292	1.5	.438	.438
687.83	4,400	11.7	51,500	.308	1.7	.524	.524
696.21				.310	2.5	.775	.542
702.58				.347	↓	.866	.607
708.59	6,750	3.02	20,400	.362	↓	.905	.634
714.64	7,600	6.07	46,100	.377	↓	.942	.660
720.73	8,700	6.10	53,100	.393	↓	.982	.686
726.85	9,700	6.10	59,100	.409	↓	1.021	.716
732.97	10,850	6.22	67,500	.425	2.5	1.061	.744
733.29	12,000	3.16	38,000	.441	3.0	1.320	.991



SEC. A-A

FORM 1319A

FIN BOX. VERTICAL PLATES –
FINGER LOADS & STRESSES

1	2	3	4	5	6	7	8	9
STA.	± P_F	AFT FUS. INERTIA LOAD	MISCELLANEOUS LOADS	TOTAL FINGER LOAD	AREA (COMP.)	AREA (TENS.)	f_c or f_t = 5/2[6 OR 7]	M.S. = $\frac{67000^*}{8}-1$
	PG. 1.05	PG. 6.17			PG. 1.05	PG. 1.05		
613.22	5,100			5,100	.262	.177	14,400	HIGH
619.03	3,600			3,600	.299	.202	8,900	
624.85	3,940	5,060		9,000	.216	.216	20,800	
630.29	4,080	2,600		6,680	.368	.248	13,500	
635.73	4,900	1,300		6,200	.286	.268	11,600	
641.18	5440	490		5,930	.435	.293	10,100	
646.62	6,000	60		6,060	.332	.312	9,700	
652.28	6,800			6,800	.437	.375	9,000	
657.04	11,300	– 310	–3975†	–15,585	.354	.354	–22,000	
663.60	14,400	–1,040		13,360	.580	.390	17,100	
669.71	15,900	–2,460	+2350‡	18,790	.652	.456	20,600	
676.01	22,500	–4,350		–26,850	.594	.405	–22,400	HIGH
681.87	25,200	–5,900		–31,100	.438	.438	–35,500	.88
687.83	52,700	–8400		–61,100	.524	.524	–58,500	.15
696.21						REF. PG. 1.15		
702.53					.866	.607		—
708.59	20,400		2500 △ 3000 □	25,900	.905	.634	20,400	HIGH
714.64	46,100		5000 ⊙ 6000 ●	57,190	.942	.660	43,200	.55
720.73	53,100		2500 △ 3000 ⊙	58,600	.982	.688	42,500	.57
726.65	59,100			59,100	1.021	.716	41,200	.62
732.97	67,500			67,500	1.061	.744	[illegible]	.47
739.29	38,000			38,000	1.320	.991	19,200	HIGH

* $F_c = F_t = .93 \times 72{,}000 = 67{,}000$ PSI.

† STRUT LOAD = 7950/2 = –3975#/SIDE } PG. 5.03
‡ " = $\frac{7050}{2} \times \frac{10}{15}$ = 2350#/SIDE

□ [illegible] LOAD STA. 708 = [illegible]/4 = [illegible]#/SIDE } PG. 2.29
⊙ [illegible] LOAD STA. 714 = 12000/2 = [illegible]#/SIDE

△ STRUT LOAD STA. 708 & 720 = 10000/4 = 2500#/SIDE } PG. 5.11
⊙ STRUT LOAD STA. 714 = 10,000/2 = 5000/SIDE

FORM 1319A

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

AIRCRAFT: C-105		REPORT No.	
		SHEET No.	1.07
		PREPARED BY	DATE
		MC CABE	12-9-55
		CHECKED BY	DATE

FIN BOX VERTICAL PLATES
FINGER ATTACHMENTS

THE FOLLOWING ANALYSIS CONTAINS SOME OF THE MORE CRITICAL FINGER ATTACHMENTS. ATTACHMENTS NOT LISTED MAY BE SUBSTANTIATED BY COMPARING THE LOADS ON PG. 1.06 WITH ANALYSIS.

STA.	LOAD (PG. 1.06	ATTACHMENTS	ALLOW. LOAD	M.S. =
681.87	31,100	6-1/4" LOCKBOLTS	55800	.79
687.83 696.21	61,100	6-5/16" LOCKBOLTS (REF PG 1.14)	87,500	.43
732.97	67,500	6-5/16" LOCKBOLTS	87,500	.30

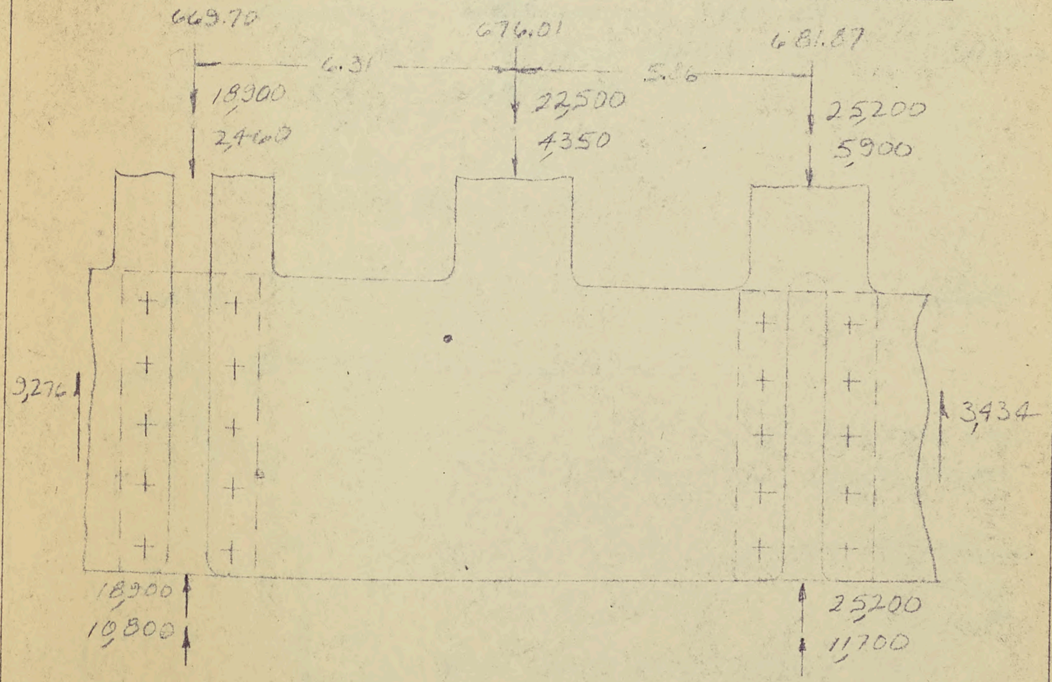
FORM 1319A

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

AIRCRAFT: C-105	REPORT No.	SHEET No 1.08
	PREPARED BY: McCABE	DATE: 12-8-55
	CHECKED BY:	DATE:

FIN BOX VERTICAL PLATES
STA. 669.705 - STA. 681.875

LOADS ON FINGERS - CASE R.P.O.				
LOADING	FUS. STA.			REF.
	669.7	676.01	681.87	
FIN ROLL	18,300	22,500	25,200	PG. 1.05
FUS. INERTIA	2,460	4,350	5,900	PG. 6.17



FIN ROLL LOAD @ STA. 676.01 IS BEAMED TO STAS. 669.7 & 681.87

REACTION @ STA. 681.87 = $\frac{22,500 \times 6.31}{12.17}$ = 11,700 LBS.

REACTION @ STA. 669.7 = 22,500 - 11,700 = 10,800 LBS.

SHEAR @ STA. 669.7 DUE TO FUS. INERTIA = 9276# (PG. 6.17)

BALANCING SHEAR @ STA. 681.87 = 9276 - 2460 - 4350 - 5900
= - 3434#

FORM 1319A

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

REPORT NO.	
SHEET NO.	1.09
PREPARED BY	DATE
McCABE	12-9-55
CHECKED BY	DATE

AIRCRAFT: C-105

FIN BOX VERTICAL PLATES
STA. 662.70 — STA 681.875
SHEAR STRESS

MAX. SHEAR = 9,276 + 10,800 − 2,460 = 17,616# (PG. 1.08)

WEB DEPTH = 5.6

t = .20 PER PLATE (NOTE WEB THICKNESS WAS REDUCED BY MACHINING)

$$f_s = \frac{17616}{5.6 \times 2 \times .20} = 7900 \text{ PSI.}$$

ALLOWABLE WEB STRESS (REF. LOCKHEED SM 350)

$b = 4.7$, $a = 10.5$ (DIMMENTIONS BETWEEN ATTACH.)

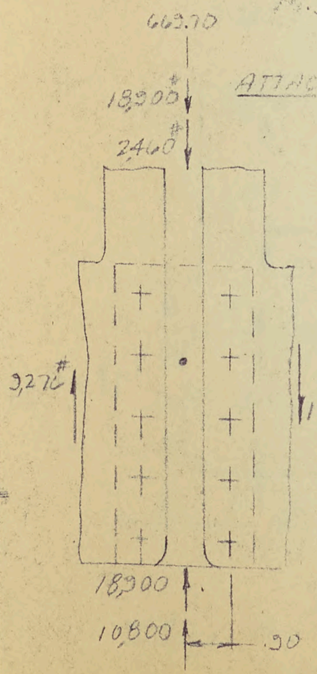
$b/a = 4.7/10.5 = .45$

$\sqrt{R} = 2.4$

$(b/t)_e = 4.7/.20 \times 2.4 = 9.8$

F_{cr} = 40,000 PSI.

$$M.S. = \frac{40,000}{7,900} - 1 = \quad \underline{\text{HIGH}}$$



ATTACHMENTS TO DIAPHRAGM

ATTACHMENTS AFT OF STA. 669.7 ARE CRIT.

MOMENT = .90 × 17,616 = 15,900 IN. LBS.

I_p = 14.38

$$\text{LOAD ON CRIT BOLT FROM MOM.} = \frac{15,900 \times 2.4}{14.38} = 2,660\#$$

$$\text{VERT. SHEAR LOAD} = \frac{18,200}{2} + 17,616 = 27,066\#$$

LOAD PER BOLT = 27,066 / 5 = 5,400#

$$\text{RESULT} = (5,400^2 + 2,660^2)^{1/2} = 5940\#$$

$$M.S. = \frac{9,300}{5,940} - 1 = \quad \underline{.56\ M.S.}$$

FORM 1319A

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

REPORT No.	
SHEET No.	1.10
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	9-14-55
CHECKED BY	
DATE	

FIN BOX VERTICAL PLATES
STA. 732.97 - STA. 742.5
LOADS

CRITICAL CASE IS R.R.O.
LOADS ARE FROM SIDE AIR LOAD ON FIN & AFT FUS. INERTIA & AIR LOADS.

FIN SKIN LOADS (PER PLATE)

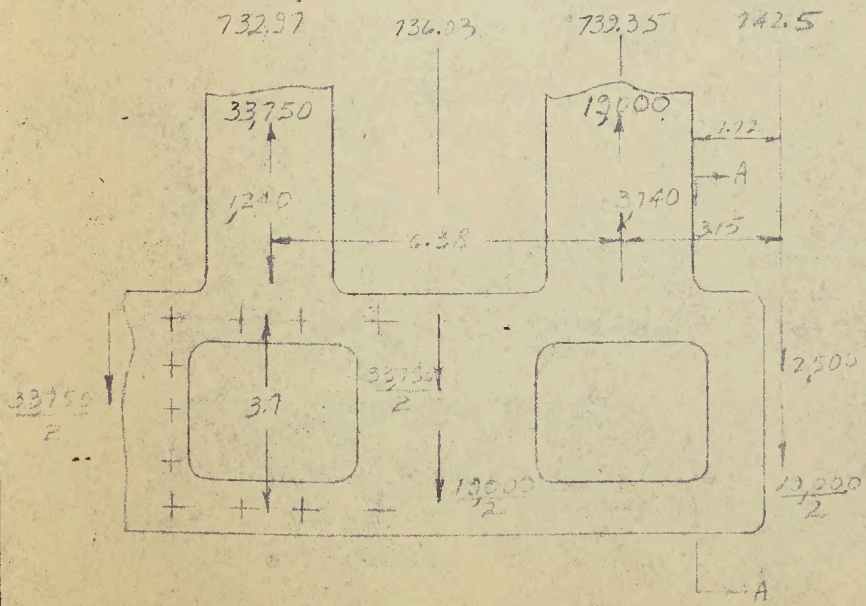
STA. 732.97 = 67,500/2 = 33,750 LBS. (PG. 1.06)

STA. 739.35 = 38,000/2 = 19,000 LBS. (PG. 1.06)

AFT FUS. INERTIA & SHEAR LOAD

TOTAL SHEAR ACTING @ STA. 742.5 = 10,000 LBS. (EST.)

LOAD PER PLATE = $\frac{10,000}{4}$ = 2,500#



NOTE: ONLY OUTER PLATE ANALYSIS IS SHOWN, HOWEVER, IT MAY BE USED TO SUBSTANTIATE THE STRENGTH OF INNER PLATES SINCE LOADING & PLATE THICKNESSES ARE SAME. INNER

FORM 1319A

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT No.	
		SHEET No. 111	
AIRCRAFT: C-105		PREPARED BY	DATE
		McCABE	3-15-55
		CHECKED BY	DATE

FIN BOX VERTICAL PLATES
STA 723.21 - STA 742.5
ATTACHMENT TO FIN @ STA. 733.35

[illegible] ATTACHMENTS = 19000 + 3740 (PG. 1.10)
= 22,740

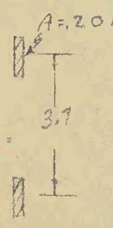
ALLOW. LOAD 5 - 5/16 [illegible] = 5 x 7,300
36,500 LBS.

$M.S. = \frac{36500}{22740} - 1 =$ .61 M.S.

BENDING SEC. A-A

MOMENT = 1.72 ($\frac{19,000}{2}$ + 2,500) (PG. 1.10)

= 20,600 IN. LBS.



SEC. A-A
(ASSUMED)

$I = 2 \times .20 \left(\frac{3.7}{2}\right)^2 = 1.37$

$f_b = \frac{20,600}{1.37} \times \frac{3.7}{2} = 27,800$ PSI.

NOT CRITICAL

SHEAR STRESS

MAX. SHEAR LOAD = 33,750/2 = 16,875 LBS. (PG. 1.10)
ASSUME [illegible] THICKNESS AS .20 IN.

$f_s = \frac{16,875}{3.7 \times .20} = 22,500$ PSI.

ALLOW. BUCKLING STRESS (REF. [illegible] D SM.33b)

$\sqrt{K} = 2.2$

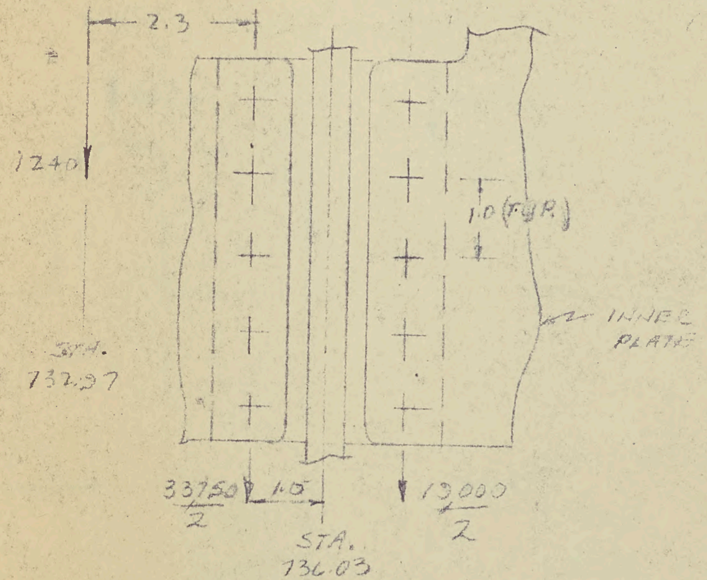
$(b/t)_e = \frac{3.7}{.20 \times 2.2} = 8.4$

$F_{cr} = 38,500$

$M.S. = \frac{38,500}{22,800} - 1 =$ .69 M.S.

FORM 1318 A

FIN BOX VERTICAL PLATES
STA. 729.31 – STA 742.5
ATTACHMENTS – INNER PLATE TO STA. 736.03 DIAPH.



MOMENT ON ATTACHMENTS $= \left(\frac{33750}{2} - \frac{13000}{2}\right) 1.0 + 2.3 \times 1240$

$= 7,400 + 2,850$

$= 10,250$ IN. LBS.

I_p (ATTACHMENTS) $= 8.5$

LOAD ON CRIT. BOLT FROM MOMENT $= \frac{10,250 \times 1.84}{8.5} = 2,220$

LOAD PER BOLT FROM SHEAR $= \frac{33750/2 + 1240}{5} = 3680^{\#}$

RESULT LOAD $= \left(\overline{3680}^2 + \overline{2220}^2\right)^{1/2}$

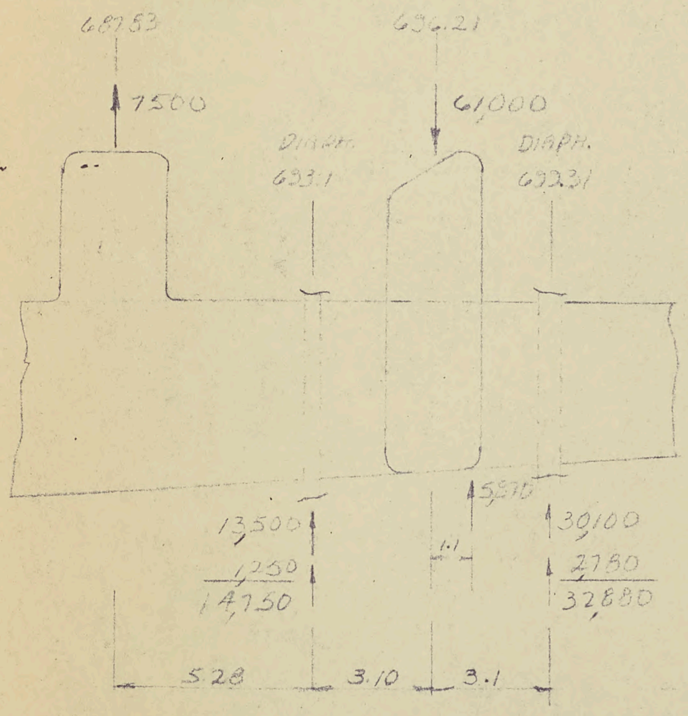
$= 4,250^{\#}$

M.S. $= \frac{4650}{4,250} - 1 =$ .09 M.S.

A. V. ROE CANADA LIMITED MALTON · ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**	REPORT NO.	
	SHEET NO. 1.13	
	PREPARED BY	DATE
AIRCRAFT: C-105	McCABE	12-1-55
	CHECKED BY	DATE

FIN BOX VERTICAL PLATES

FINGER LOADS DUE TO ELEV. JACK & [illegible]



JACK LOAD VERT. COMPONENT = 5870 LBS. (PG. 2.22)

DIAPH. 693.1 LOADS = 14,750# (PG. 2.23)

DIAPH. 699.31 LOADS = 32,880# (PG. 2.26)

ASSUME LOADS ARE REACTED @ FINGERS @ STA. 687.53 & STA. 696.21.

STA 696.21 REACTION = (11.48 × 32,880 + 9.48 × 5,870 + 5.28 × 14,750) / 8.38

= (376,000 + 55,600 + 78,000) / 8.38

= 61,000 LBS.

STA 687.53 REACTION = 61,000 − (32,880 + 5,870 + 14,750)

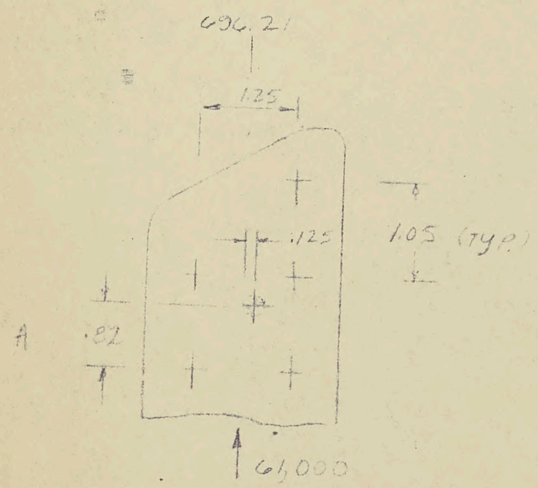
= 61000 − 53,500

= 7,500 LBS.

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	1.14
		PREPARED BY	DATE
		McCABE	12-1-55
		CHECKED BY	DATE

FIN BOX VERT. PLATES
FINGER LOADS DUE TO ELEV. JACK YOKE FITTING
STA 696.21 ATTACHMENTS
LOAD ON FINGER = 61,000 LBS. (REF. PG. 1.13)



MOMENT ON ATTACHMENTS 61,000 × .125 = 7500 IN. LBS.
$I_P = 4.95$.
LOADS ON CRIT. BOLT FROM MOMENT
HORIZ. COMPONENT = $\frac{7500 \times .82}{4.95}$ = 1240 LBS.
VERT. COMPONENT = $\frac{7500 \times .85}{4.95}$ = 1290 LBS.
LOAD PER BOLT FROM VERT. LOAD = $\frac{61,000}{5}$ = 12,200 LBS.
RESULTANT $\left[(12200 + 1290)^2 + 1240^2\right]^{1/2}$
13,500 LBS.
ALLOW. LOAD = 14,600 LBS.

M.S. = $\frac{14,600}{13,500} - 1 =$ .08 M.S.

FORM 1319A

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

AIRCRAFT: C-105		REPORT No.
		SHEET No. 115
		PREPARED BY: McCABE — DATE: 12-13-55
		CHECKED BY: — DATE:

FIN BOX [illegible]

FINGER [illegible] DUE TO ELEV. JACK [illegible]

STA. 636.21 FINGER STRESS

END LOAD = 61,000

AREA = 2 (.33 · 2.3)

= 1.52

$f_c = \frac{61000}{1.52}$

= 40,000 PSI

$M.S. = \frac{67000}{40000} - 1 =$ .67 M.S.

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

AIRCRAFT: C-105		REPORT NO:	
		SHEET NO. 2.01	
		PREPARED BY	DATE
		McCABE	
		CHECKED BY	DATE

PART II — DIAPHRAGMS

FORM 1319A

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

REPORT No.	
SHEET No.	202

AIRCRAFT:		PREPARED BY	DATE
C-105		McCABE	
		CHECKED BY	DATE

DIAPHRAGMS

DESCRIPTION

THE PRINCIPAL FUNCTION OF THE DIAPHRAGMS IS TO TRANSFER FIN SKIN DIFFERENTIAL LOADS TO THE WING UPPER & LOWER SURFACES.

ALL DIAPHRAGMS BETWEEN STA. 607.63 & STA. 687.83 ARE FABRICATED PARTS, THE FLANGES BEING BOLTED TO THE WEBS. DIAPHRAGMS BETWEEN STA. 693.11 & STA. 736.03 ARE FORGED PARTS INCORPORATING INTEGRAL FLANGES & WEBS.

IN THE ANALYSIS THAT FOLLOWS, IN GENERAL, ONLY THE MOST CRITICAL ITEMS ARE ANALYZED. DIAPHRAGMS NOT INCLUDED IN ANALYSIS MAY BE SUBSTANTIATED BY LOAD & ANALYSIS COMPARISON.

FORM 1319 A

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

REPORT NO.
SHEET NO. 2.03

AIRCRAFT: C-105

PREPARED BY	DATE
MC CABE	11-18-55
CHECKED BY	DATE

DIAPHRAGMS
WEB STRESSES - STA 607.63 - STA 736.03

1	2	3	4	5	6	7	8	9
STA.	p	d	$P_r = p.d$	MISCELLANEOUS LOADS	$S_{(TOTAL)}$ = 4 + 5	h = WEB DEPTH	t = WEB THICKNESS	$f_s = S/h \cdot t$
	REF PG 1.03							
607.63	550	13.6	7500	(REF. PG. 2.11)				
624.85	700	14.1	9,860	(REF. 7/0562/25				
635.73	900	10.88	9,800		9,800	8.6	2x.081	7,000
646.62	1,100	11.10	12,200		12,200	7.8	2x.031	8,600
657.34	1,900	11.32	21,500	7,950/2 ‡	25,475	6.8	2x.125	15,000
669.70	3000	12.41	37,200	7,050/2 ‡	40,725	6.4	2x.150	21,200
681.87	4,300	8.84	38,000		38,000	5.7	2x.188	17,700
687.83	4,400	11.7	51,500	(REF. PG. 2.17)				
693.11				(REF. PG. 2.23)				
699.31				(REF. PG. 2.26)				
705.58								
711.60	7,000	6.05	42,300	(REF. PG. 2.31)				
717.67	7,900	6.09	48,100	2500 △ 2280 ⊙	52,850	4.9	.50	31,800*
723.79	9,300	6.12	57,000		57,000	4.9	.50	35,000*
729.91	10,400	6.12	63,600		63,600	4.9	.50	35,000*
736.03	11,000	5.63	62,000		62,000	4.9	.50	38,000*

$$* \; f_s = \frac{S}{h \cdot t} \times \frac{3}{2}$$

‡ REF. PG. 5.03

△ FROM STRUT LOAD = 10,000/4 = 2,500# (PG. 5.06)

⊙ FROM ENGINE LOAD = $\frac{.38 \times 12000}{2}$ = 2,280# (PG 2.29)

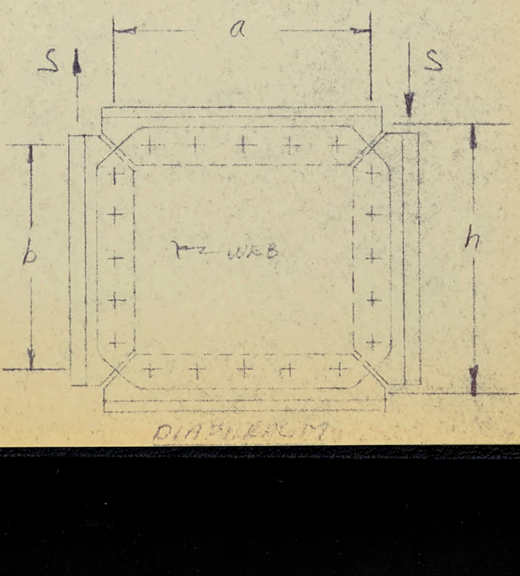
FORM 1319A

DIAPHRAGMS

WEB STRESSES - STA. 607.63 - STA. 736.03

(1)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
STA.	a	b	b/a	$\sqrt{K}$	(b/t_e) = (11)/(8)(13)	Fcr	M.S. = $\frac{Fcr}{f_s}$ - 1
			REF. LOCKHEED S.M. 336				[(15)/(9)] - 1
607.63				(REF. PG. 2.11)			
624.85				(REF. 7/0562/25			
635.73	7.6	6.6	.87	2.74	30.	12,000	.72
646.62	6.8	6.8	1.0	2.9	25.8	15,000	.75
657.94	6.8	5.8	.85	2.7	17.2	28,000	.86
669.70	6.8	5.3	.78	2.64	13.4	33,500	.58
681.87	6.7	4.8	.72	2.6	9.8	37,500	1.12
687.83				(REF. PG. 2.17)			
693.11				(REF. PG. 2.23)			
699.31				(REF. PG. 2.26)			
705.58			BUCKLING OF WEB NOT CRITICAL			45,000*	
711.60				"			(REF. PG. 2.31)
717.67				"			.41
723.79				"			.28
729.91				"			.15
736.03				"		45,000*	.18

* ULT. SHEAR ALLOW. = 45,000 PSI. (ANC-5)



DIAPHRAGM

FORM 1319A

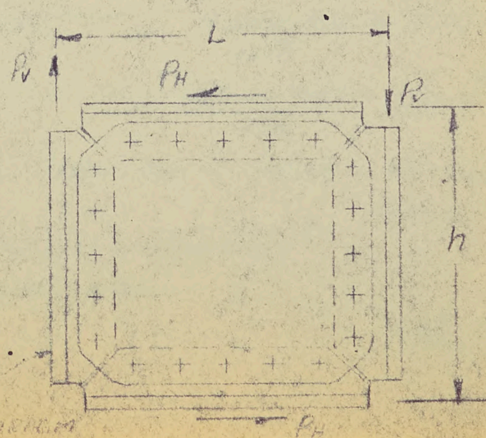
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.
SHEET No. 2.05

AIRCRAFT:	PREPARED BY	DATE	CHECKED BY	DATE
C-105	McCABE	11-18-55		

DIAPHRAGMS
FLANGE LOADS — STA. 607.63 - STA. 736.03

1	2	3	4	5
STA.	P_V	h	L	$P_H = P_V \cdot L/h$
	PG. 2.03			
607.63	7500	11.21	6.59	4,400
624.85	9,860	10.03	7.91	7,770
635.73	9,800	9.28	8.39	8,850
646.62	12,200	8.58	8.67	12,320
657.94	21,500	7.62	8.79	24,900
669.70	37,200	7.06	8.71	45,900
681.87	38,000	6.46	8.45	49,700
687.83	51,500	6.1	8.23	69,500
693.11	—			
699.31	—			
705.58	—			
711.60	42,300	(REF.	PG. 2.30)	
717.67	48,100	6.2	6.74	52,200
723.79	57,000	6.2	6.36	58,500
729.91	63,600	6.2	5.9	60,000
736.03	62,000	5.7	5.5	60,000



FORM 1319A

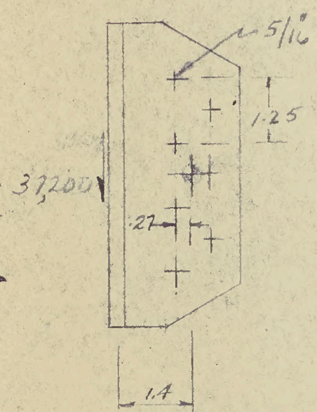
AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ATTACHMENT TO FUSELAGE	REPORT No.	
		SHEET No. 2.06	
		PREPARED BY: McCABE	DATE: 3-15-55
		CHECKED BY:	DATE:

DIAPHRAGMS

FLANGE ATTACHMENTS - STA 663.7

VERTICAL ATTACHMENT TO WEB



LOAD ON FLG. = 37,200# (PG. 2.05)

MOMENT = 1.4 × 37,200 = 52,000 IN.LBS.

$I_P = 11.6$

LOAD ON CRITICAL BOLT FROM MOMENT

HORIZ. COMPONENT = $\frac{1.87 \times 52000}{11.6} = 8400^{\#}$

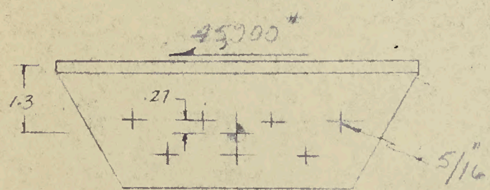
VERT. COMPONENT = $\frac{.27 \times 52000}{11.6} = 1210^{\#}$

LOAD PER BOLT FROM VERT. SHEAR = 37200/7 = 5300

RESULTANT = $\left[(5300+1210)^2 + \overline{8400}^2\right]^{1/2}$ = 10400 LBS.

M.S. = $\frac{12800}{10400} - 1 =$ .23 M.S.

HORIZONTAL ATTACHMENT TO WEB



LOAD ON FLG. = 45,900# (PG. 2.05)

MOMENT = 1.3 × 45,900 = 59,600 IN.LBS.

$I_P = 12.8$

LOAD ON CRIT. BOLT FROM MOMENT

VERTICAL COMPONENT = $\frac{59600 \times 2.0}{12.8} = 9300^{\#}$

HORIZ. COMPONENT = $\frac{59600 \times .27}{12.8} = 1260^{\#}$

LOAD PER BOLT FROM HORIZ. SHEAR = 45,900/7 = 6550 LBS.

RESULTANT = $\left[(6550+1260)^2 + \overline{9300}^2\right]^{1/2}$ = 12100 LBS.

M.S. = $\frac{12800}{12100} - 1$ .06 M.S.

FORM 1319 A

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

REPORT No.
SHEET No 2.07

AIRCRAFT: C-105

PREPARED BY: McCABE
DATE: 12-8-55
CHECKED BY
DATE

DIAPHRAGMS

FLANGE ATTACHMENTS - STA 669.7

HORIZ. FLANGE SHEAR

AT OUTER ROW OF ATTACHMENTS TO WEB,

$$f_s = \frac{45900}{5.8 \times .31} \times \frac{3}{2} = 38300 \text{ PSI.}$$

$$F_s = 45,000 \text{ PSI}$$

$$M.S. = \frac{45000}{38300} - 1 = \qquad .17 \text{ M.S.}$$

VERTICAL FLANGE SHEAR

AT OUTER ROW OF ATTACHMENTS TO WEB,

$$f_s = \frac{37200}{5.0 \times .31} \times \frac{3}{2} = 36,000 \text{ PSI.}$$

$$F_s = 45,000 \text{ PSI.}$$

$$M.S. = \frac{45000}{38300} - 1 = \qquad .18 \text{ M.S.}$$

FORM 1319A

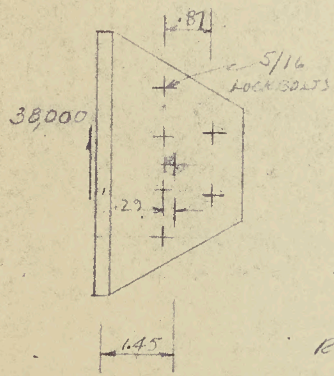
AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ATTACHMENT TO FUSELAGE	REPORT NO.	
		SHEET NO. 2.08	
		PREPARED BY: McCABE	DATE: 3-15-55
		CHECKED BY:	DATE:

DIAPHRAGMS

FLANGE ATTACHMENTS — STA. 681.87

VERTICAL ATTACHMENT TO WEB



LOAD ON FLG. = 38,000 (PG. 2.05)

MOMENT = 1.45 × 38000 = 55,000 IN. LBS.

$I_P = 9.94$

LOAD ON CRIT. BOLT FROM MOMENT

HORIZ. COMPONENT = $\frac{1.62 \times 55000}{9.94}$ = 9000

VERT. COMPONENT = $\frac{.29 \times 55000}{9.94}$ = 1600

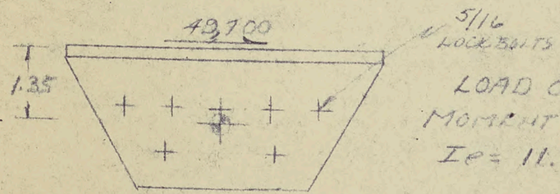
LOAD PER BOLT FROM VERT. SHEAR = 38,000/6 = 6330

RESULTANT = $\left[(6330+1600)^2 + 9000^2\right]^{1/2}$

13,000 LBS.

M.S. = $\frac{14,600}{13,000} - 1$ = .12 M.S.

HORIZONTAL ATTACHMENT TO WEB



LOAD ON FLG. = 49,700 (PG. 2.05)

MOMENT = 1.35 × 49,700 = 67,100 IN. LBS.

$I_P = 11.23$

LOAD ON CRITICAL BOLT FROM MOMENT

VERT. COMPONENT = $\frac{1.87 \times 67100}{11.23}$ = 11,200#

HORIZ. COMPONENT = $\frac{.35 \times 67100}{11.23}$ = 2080#

LOAD PER BOLT FROM HORIZ. SHEAR = 49,700/7 = 7,100 LBS.

RESULTANT = $\left[(11200)^2 + (2080+7100)^2\right]^{1/2}$

14400

M.S = $\frac{14,600}{14400} - 1$ = .02 M.S.

FORM 1319A

DIAPHRAGMS

FLANGE ATTACHMENTS:- STA 681.87

HORIZ. FLANGE SHEAR

AT OUTER ROW OF ATTACHMENTS TO WEB

$$f_s = \frac{49700}{5.6 \times .35} \times \frac{3}{2} = 38{,}000 \text{ PSI.}$$

$$F_s = 45{,}000 \text{ PSI.}$$

$$M.S. \quad \frac{45000}{38{,}000} - 1 = \qquad .18 \text{ M.S.}$$

VERT. FLANGE SHEAR

AT OUTER ROW OF ATTACHMENTS TO WEB

$$f_s = \frac{38{,}000}{4.65 \times .35} \times \frac{3}{2} = 35{,}000 \text{ PSI.}$$

$$F_s = 45{,}000$$

$$M.S. = \frac{45000}{35{,}000} - 1 = \qquad .28 \text{ M.S.}$$

FORM 1319A

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

REPORT No.
SHEET No. 2.10

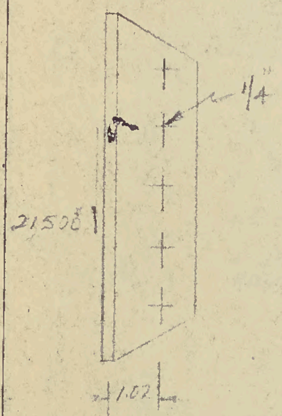
AIRCRAFT: C-105

PREPARED BY	DATE
MC CABE	12-8-55
CHECKED BY	DATE

DIAPHRAGMS

FLANGE ATTACHMENTS – STA 657.94

VERTICAL ATTACHMENT TO WEB



LOAD ON FLG. = 21,500# (PG. 2.05)

MOMENT = 1.02 × 21500 = 22,000 IN. LBS

I_P = 11.0

LOAD ON EXT BOLT FROM MOMENT = $\frac{22000 \times 2.1}{11.0}$

= 4200#

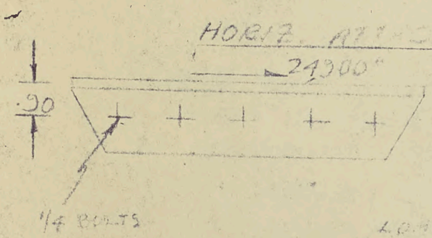
LOAD PER BOLT FROM SHEAR = $\frac{21500}{5}$ = 4300#

RESULTANT LOAD = $(4200^2 + 4300^2)^{1/2}$ = 6000#

ALLOW. LOAD = 8560

M.S. = $\frac{8560}{6000} - 1$ = .43 M.S.

HORIZ. ATTACHMENT TO WEB



LOAD ON FLG. = 24,900# (PG. 2.05)

MOMENT = .90 × 24,900 = 22,400 IN. LBS

I_P = 15.6

LOAD ON EXT. BOLT FROM MOMENT = $\frac{24,900 \times 2.5}{15.6}$

= 4,000#

LOAD PER BOLT FROM SHEAR LOAD = $\frac{24,900}{5}$

= 5,000#

RESULTANT = $(4000^2 + 5000^2)^{1/2}$ = 6,400#

M.S. = $\frac{8560}{6,400} - 1$ = .34 M.S.

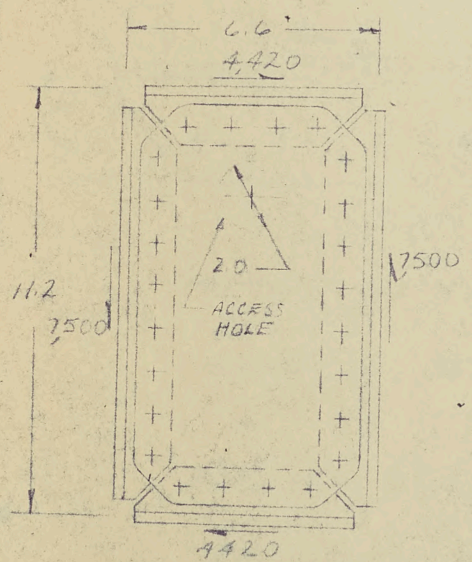
FORM 1319A

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105		REPORT No.	
		SHEET No.	2.11
		PREPARED BY: McCABE	DATE: 11-23-55
		CHECKED BY	DATE

DIAPHRAGMS
STA. 607.63



LOAD ON DIAPH. FROM FIN = 7,500# (PG. 2.03)

LOAD ON UPPER & LWR. FLGS.

$$= \frac{6.6 \times 7500}{11.2} = 4420 \text{ LBS.}$$

WEB SHEAR

$$q_{NET} = \frac{4420}{(6.0-2.0)} = 1,110 \text{ \#/IN.}$$

$$f_s = \frac{1110}{2 \times .077} = 7200 \text{ PSI.}$$

WEB BUCKLING ALLOWABLE

DUE TO HOLE, AN EFFECTIVE "t" WILL BE USED TO COMPUTE BUCKLING ALLOW.

AREA PLATE = 10.5 × 6.0 = 63.0

AREA HOLE = $2.0^2 \pi/4$ = 3.1

$$t_{(EFF)} = .081 \left(\frac{63.0-3.1}{63}\right) = .077$$

$b = 6.0$, $a = 10.5$

$b/a = 6/10.5 = .57$

$\sqrt{K} = 2.48$

$$(b/t)_e = \frac{6.0}{.077 \times 2.48} = 31$$

REF. LOCKHEED SM336

$F_{cc} = 10,000$ PSI.

MARGIN OF SAFETY

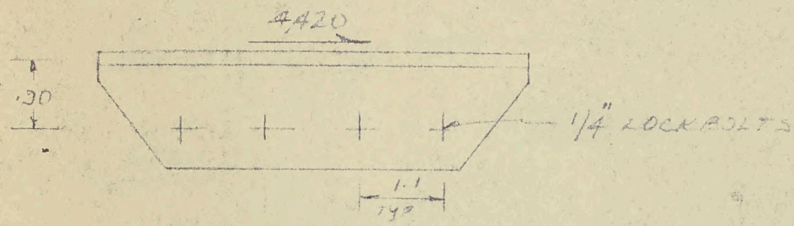
$$M.S. = \frac{10,000}{7200} - 1 = .39 \text{ M.S.}$$

FORM 1319A

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

REPORT NO.		
SHEET NO. 2.12		
AIRCRAFT: C-105	PREPARED BY: McCABE	DATE: 11-23-55
	CHECKED BY:	DATE:

DIAPHRAGMS
STA. 607.63
HORIZ. FLANGE ATTACHMENT TO WEB



MOMENT ON ATTACHMENTS = .30 × 4,420 = 3,980 IN. LBS.

$I_p = 6.0$

LOAD ON CRIT. BOLT FROM MOMENT $= \dfrac{1.65 \times 3980}{6}$

$= 1090$ LBS.

LOAD PER BOLT FROM SHEAR $= \dfrac{4420}{4} = 1105$ LBS.

RESULTANT $= (1090^2 + 1105^2)^{1/2} = 1,550$ LBS.

ALLOW. LOAD 1/4" BOLTS IN 2 × .081 = 6,240 LBS.

M.S $= \dfrac{6240}{1550} - 1 =$ HIGH M.S.

FLANGE STRESS NOT CRITICAL
VERTICAL ATTACHMENTS TO WEB O.K.

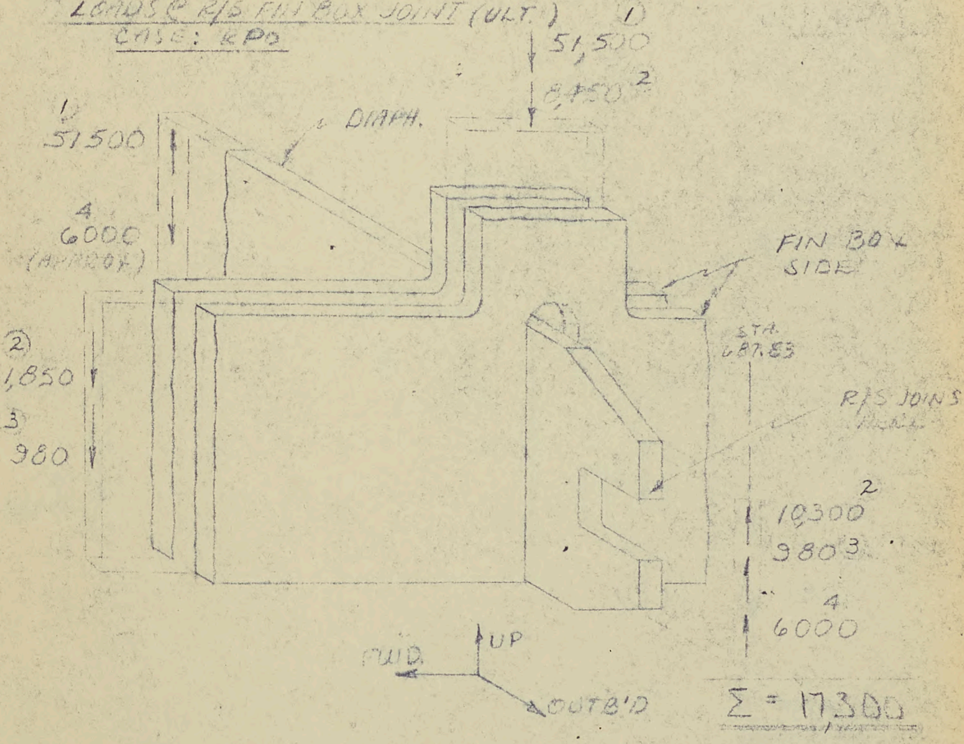
FORM 1319A

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

AIRCRAFT: C-105		REPORT NO:	SHEET NO: 2.13
		PREPARED BY: McCABE	DATE: 11-25-55
		CHECKED BY:	DATE:

DIAPHRAGMS
STA. 687.83

LOADS @ R/S FIN BOX JOINT (ULT.)
CASE: RPD



1 DIRECT LOAD FROM FIN SKIN DUE TO SIDE LOAD ON FIN (PG 2.05)
2 AFT FUS. INERTIA LOAD (REF. PG. 6.17)
3 FIN & FIN BOX INERTIA LOAD (STA. 624 - STA. 687) (ESTIMATED)
4 SPAR SHEAR DUE TO FIN ROLL MOMENT (ESTIMATED, R.VALE)

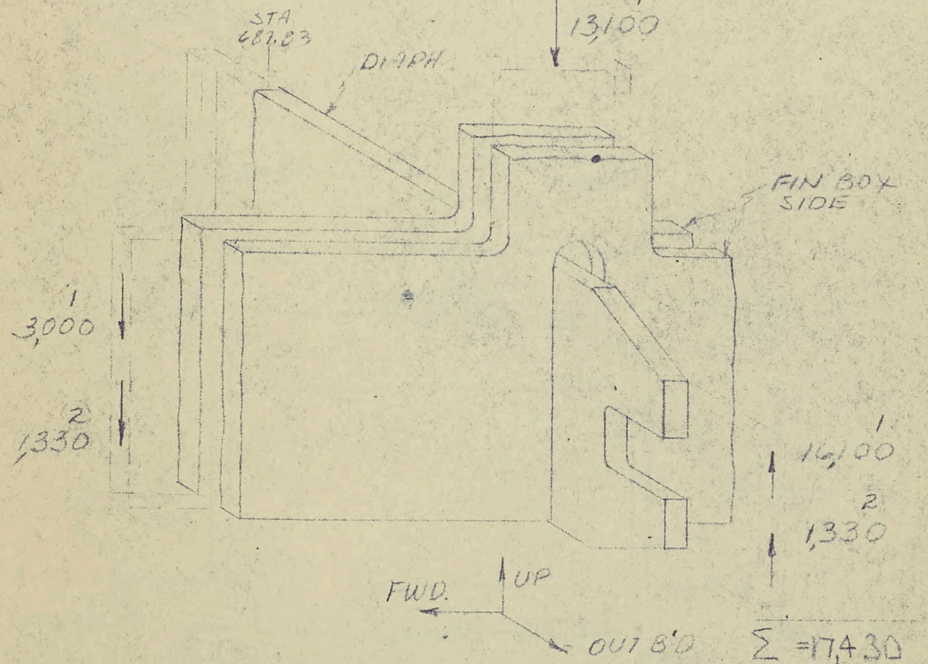
FORM 1319A

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

REPORT No.	
SHEET No.	2.14
PREPARED BY	DATE
MCCABE	11-25-55
CHECKED BY	DATE

AIRCRAFT: C-105

DIAPHRAGMS
STA. 687.83
LOADS @ R/S FIN BOX JOINT (ULTIMATE)
CASE: SYMM. FLT.



$\Sigma = 17{,}430$

1. AFT FUS. INERTIA LOAD (REF PG. 6.14)
2. FIN & FIN BOX INERTIA LOAD (STA. 624 → STA. 687) (APPROX)

The shear fittings on the wing have been stressed for a load of 18,600 lbs (ULT). This will not be changed.

L.W.

P.J. McKenzie
25.11.55

FORM 1319A

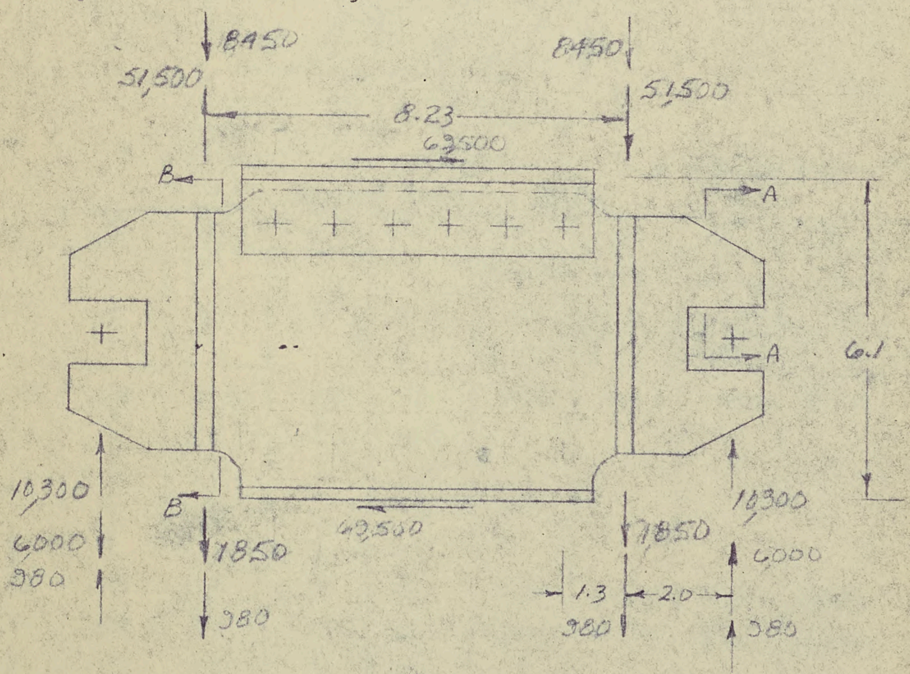
AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	
SHEET NO.	2.15
AIRCRAFT	C-105
PREPARED BY	MCCABE
DATE	7-7-55
CHECKED BY	
DATE	

DIAPHRAGM
STA. 687.83

CRITICAL DESIGN CASE FOR WEB AND FLANGES IS R.P.D.

(APPLIED LOADS, REF PG. 2.13)



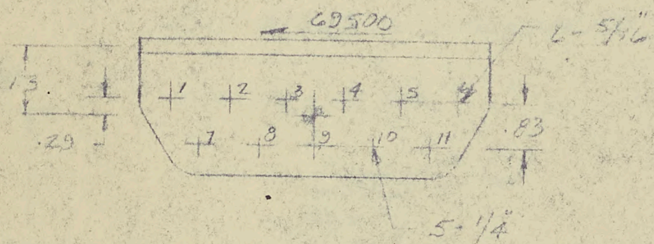
FLANGE COUPLE LOADS $= \frac{51,500 \times 8.23}{6.1} = 63,500$ LBS.

FORM 1319A

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

AIRCRAFT: C-105		REPORT No.	SHEET No. 2.16
		PREPARED BY: McCABE	DATE: 10-18-55
		CHECKED BY	DATE

DIAPHRAGM
STA. 687.83
UPPER FLANGE ATTACHMENT TO WEB



MOMENT ON ATTACHMENTS = 1.3 × 69,500 = 90,300 IN.LBS.
M/I = 90,300/47.97 = 1880

1	2	3	4	5	6	7	8	9	10	11
ITEM	AREA	Z	y	$A \cdot \bar{Z}^2$	$A \cdot \bar{y}^2$	LOAD FROM MOMENT HORIZ. $\frac{M}{I} \cdot Z \cdot A$	LOAD FROM MOMENT VERT. $\frac{M}{I} \cdot y \cdot A$	LOAD FROM HORIZ SHEAR $\frac{69500 \cdot A}{\Sigma A}$	TOTAL HORIZ LOAD 7 + 9	RESULT. $\sqrt{8^2 + 10^2}$
1	1.55	.29	2.8	.12	12.1	850	8160	7,540	8390	11,700
2			1.67		4.3					
3			.56		.5					
4			.56		.5					
5			1.67		4.3					
6	1.55	.29	2.8	.12	12.1	850	8,160	7,540	8390	11,700
7	1.0	.54	2.2	.29	4.8	-1,010	4,130	4,860	3,850	5,620
8			1.1		1.2					
9			0		0					
10			1.1		1.2					
11	1.0	.54	2.2	.29	4.8	-1010	4130	4860	3850	5620
Σ	14.3			2.17	45.8					

$$M.S. = \frac{14,600}{11,700} - 1 =$$

.25 M.S.

FORM 1319A

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO.	2.17
		PREPARED BY	DATE
		McCABE	7-7-55
		CHECKED BY	DATE

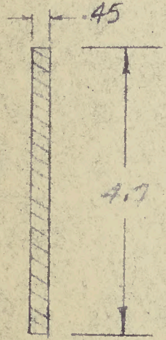
DIAPHRAGMS
STA. 627, 83
WEB STRESS

WEB SHEAR = 51500 LBS. (PG. 2.15)

WEB AREA 4.7 × .45 = 2.11

$f_s = \dfrac{51500}{2.11} \times \dfrac{3}{2} = 36{,}600$ PSI

$F_s = 45{,}000$ PSI.



$M.S. = \dfrac{45000}{36{,}600} - 1 =$ .23 M.S.

SEC. B-B (PG. 2.15)

SHEAR - SEC. A-A (PG. 2.15)

CRIT. CASE SYMM. FLT. (REF. PG. 2.14 FOR LOADS)

SPAR SHEAR = 16,100 + 1,330 = 17,430 LBS.

AREA = 1.6 × .45 = .72 IN.^{2}

$f_s = \dfrac{17{,}430}{.72} \times \dfrac{3}{2} = 36{,}400$ PSI.

$M.S. = \dfrac{45{,}000}{36{,}400} - 1 =$ .23 M.S.

FLANGE SHEAR STRESS

FLANGE LOAD = 69,500 LBS. (PG. 2.15)

$f_s = \dfrac{69{,}500}{2(6.9 \times .20)} \times \dfrac{3}{2} = 37{,}800$ PSI.

$F_s = 45{,}000$ PSI.

$M.S. = \dfrac{45000}{37{,}800} - 1 =$ .19 M.S.

FORM 1319A

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

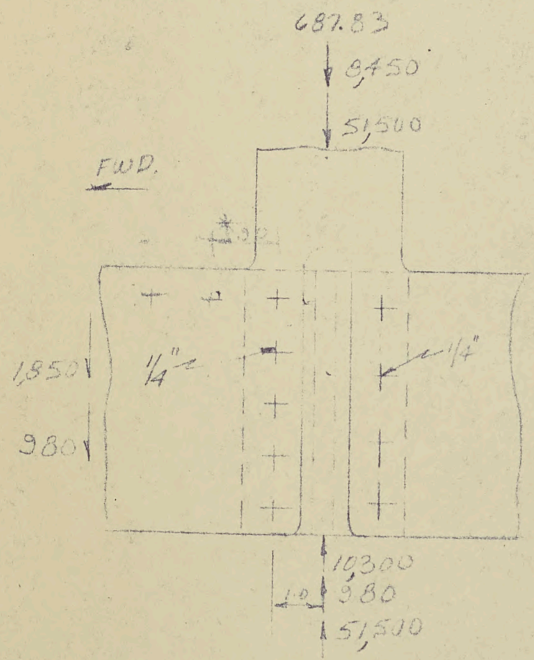
REPORT NO.
SHEET NO. 2.18

AIRCRAFT:		PREPARED BY	DATE
C-105		McCABE	12-7-55
		CHECKED BY	DATE

DIAPHRAGMS
- STA. 687.83
ATTACHMENT TO VERT. PLATES

LOADS

FIN SKIN LOAD = 51,500 LBS.
FIN & FIN BOX INERTIA = 980 LBS.
AFT. FUS. INERTIA (FINALE LOAD) = 8,450 LBS.
AFT FUS. INERTIA (REACTING SHEAR) = 10,300 LBS.
(PG. 2.13)



* DUE TO SHOP ERROR, BOLT PITCH IS REDUCED TO APPROX ... ON THIS ... BOLT ... BE ALLOWED ON THE FIRST SIX AIRCRAFT.
OCT 1 1956

FWD. SIDE ATTACHMENTS

SHEAR ON FWD. BOLTS $= \dfrac{51,500 + 8,450}{2} + 1850 + 980$

$= 32,805$ LBS.

SHEAR PER BOLT $= 32,805 / 5 = 6,560$ LBS.

MOMENT ON BOLTS $= 1.0\,(1850 + 980) = 2,830$ IN.LBS.

$I_P = 10.0$

LOAD ON CRIT. BOLT FROM MOMENT $= 2830 \times 2/10 = 566$#

RESULTANT $= (\overline{6560}^2 + \overline{566}^2)^{1/2} = 6,570$#

MS $= \dfrac{9300}{6460} - 1 =$ .44 M.S.

FORM 1319A

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

AIRCRAFT: C-105	
REPORT No.	
SHEET No. 2.19	
PREPARED BY: McCABE	DATE: 12-7-55
CHECKED BY:	DATE:

DIAPHRAGMS
STA. 687.83
ATTACHMENT TO VERT. PLATES
AFT SIDE ATTACHMENTS

$$SHEAR = (51{,}500 + 8{,}450)/2 = 29{,}975^{\#}$$

$$SHEAR\ PER\ BOLT = \frac{29{,}975}{4} = 7{,}500^{\#}$$

$$M.S. = \frac{9300}{7{,}500} - 1 = \quad .24\ M.S.$$

FORM 1319A

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

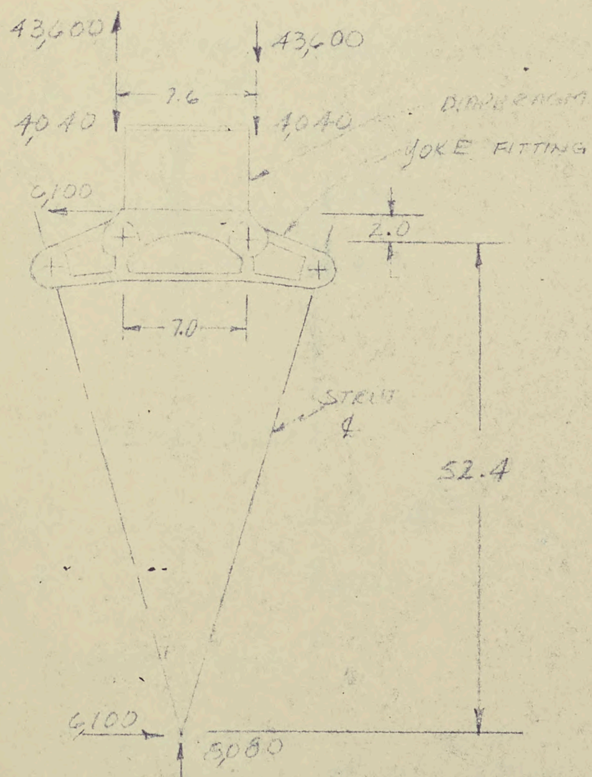
REPORT No.	
SHEET No.	2.20
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	11-24-55
CHECKED BY	
DATE	

DIAPHRAGMS
LOADS ON STA. 693.11 & STA. 699.31 DIAPHRAGMS

LOADS ON FUS. STRUTS ARE TRANSFERRED THROUGH YOKE FITTING & REACTED @ DIAPHRAGMS @ STA. 693.11 & STA. 699.31

STRUT LOADS

SIDE LOAD = 6,100 LBS. REF. D. HAYWARD
VERT. LOAD = 8080 LBS. REF. J. SCOTT



FIN SKIN REACTIONS FROM VERT. LOAD
= 8080/2 = 4040 LBS.
FIN SKIN REACTIONS FROM SIDE LOAD
$= \frac{54.4 \times 6{,}100}{7.6} = 43{,}600$ LBS.

FORM 1319 A

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

REPORT No.
SHEET No 2.21

AIRCRAFT: C-105

PREPARED BY	DATE
McCABE	11-24-55
CHECKED BY	DATE

DIAPHRAGMS
LOADS ON STA. 693.11 & STA 699.31 DIAPHRAGMS

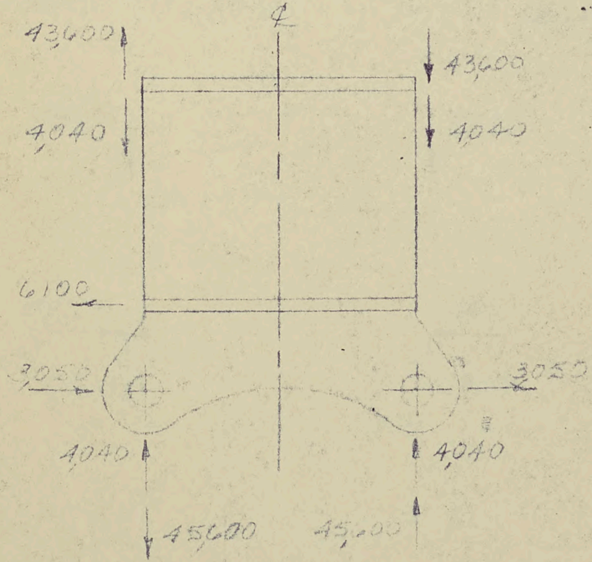
LOADS ON DIAPHRAGM LUGS

LOADS FROM VERT. LOAD = $\frac{8080}{2}$ = 4040 LBS.

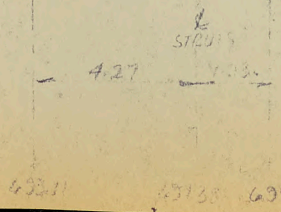
LOADS FROM SIDE LOAD = $\frac{52.4 \times 6100}{7.0}$ = 45,600 LBS.

AND $\frac{6,100}{2}$ = 3050#

SUMMARY OF LOADS ON DIAPHS. STA 693.11 & STA. 699.31 FROM FUS. STRUT LOADS



A SIMPLE DISTRIBUTION WILL BE ASSUMED IN DETERMINING THE AMOUNT OF THE ABOVE LOADS DISTRIBUTED TO ADJACENT DIAPHRAGMS.



STA. 693.11 DIAPH. = 1.93/6.2 × LOAD = .31 × LOAD
STA. 699.31 DIAPH. = 4.27/6.2 × LOAD = .69 × LOAD

FORM 1319 A

A. V. ROE CANADA LIMITED MALTON · ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO.	
		SHEET NO. 2.22	
AIRCRAFT: C-105		PREPARED BY	DATE
		McCABE	11-24-55
		CHECKED BY	DATE

DIAPHRAGMS

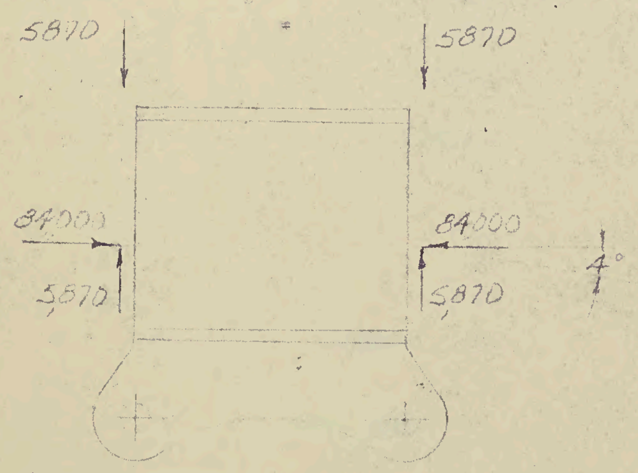
LOADS ON STA. 633.11 & STA. 633.31 DIAPHRAGMS

- LOADS FROM ELEV. JACK ARE IMPOSED ON DIAPHS STA. 633.11 & STA. 633.31 BY ELEV. JACK FITTING.

ELEV. JACK LOAD = 105,200# ULT. (REF. 7/0562/26, PG. 16)

ELEV. JACK LOAD INCORPORATES A 1.25 CONTROL FACTOR. SINCE LOAD WILL BE COMBINED WITH FUS. STRUT LOADS 1.25 FACTOR WILL BE REMOVED. THEREFORE,

$$\text{REDUCED ELEV. JACK LOAD} = \frac{105{,}200}{1.25} = 84300 \text{ LBS.}$$



JACK LOAD HORIZ. COMPONENT = 84300 COS 4°
= 84000 LBS.

JACK LOAD VERT. COMPONENT = 84300 SIN 4°
= 5870 LBS.

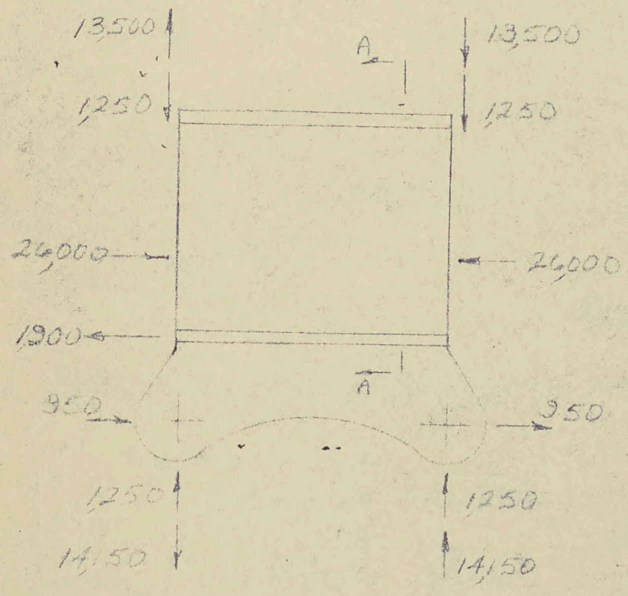
IN DISTRIBUTING JACK LOADS TO DIAPHRAGMS 633.11 & 633.31 USE RATIOS USED IN DISTRIBUTING STRUT LOADS. (REF. PG. 2.21)

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

AIRCRAFT: C-105		REPORT No.	
		SHEET No. 2.23	
		PREPARED BY: McCABE	DATE: 11-29-55
		CHECKED BY:	DATE:

DIAPHRAGMS
STA. 693.11 DIAPHRAGM

FUS. STRUT & ELEV. JACK LOADS
LOADS REF. PGS. 2.21 & 2.22



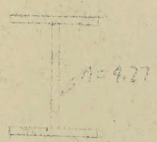
WEB STRESS

WEB SHEAR = 13,500 + 1,250 = 14,750 LBS.

$f_s = \frac{14750}{5.4 \times 40} = 6,800$ PSI.

END LOAD = 24,000 LBS.

$f_c = \frac{24,000}{4.27} = 6,100$ PSI.



SEC. A-A

WEB STRESS NOT CRITICAL

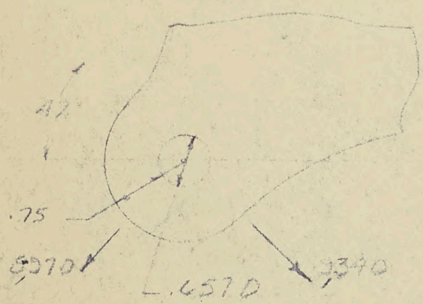
FORM 1319A

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO.	2.24
		PREPARED BY	DATE
		McCABE	11-29-55
		CHECKED BY	DATE

DIAPHRAGMS
STA. 695.11 DIAPHRAGM
LUGS

TRANSVERSE & AXIAL TENSION LOAD



TRANSVERSE LOAD = (14150-1250) SIN 42°
+ 950 COS 42°
= 8630 + 710
= 9340 LBS.

AXIAL LOAD = (14150-1250) COS 42°
- 950 SIN 42°
= 9600 - 630
= 8970 LBS. (TENSION)

ALLOWABLE TRANSVERSE LOAD (REF LUG ANALYSIS, CORRONE)

$$A_{AV.} = \frac{6}{3/A_1 + 1/A_2 + 1/A_3 + 1/A_4}$$
$$= \frac{6}{8.8 + 3.4 + 3.4 + 2.9} = .324$$

$A_{br} = .657 \times .397 = .261$

$\frac{A_{AV}}{A_{br}} = \frac{.324}{.261} = 1.24$

$K_{try} = 1.21$

$F_t = .93 \times 71,000 = 66,000$

$P_{tru} = 1.21 \times 66,000 \times .261 = \underline{20,800}$ LBS.

ALLOWABLE AXIAL LOAD (REF LUG ANALYSIS, CORRONE)

$a = 1.07$	$a/D = 1.07/.657 = 1.63$
$D = .657$	$w/D = 2.14/.657 = 3.25$
$w = 2.14$	$D/t = .657/.397 = 1.65$
$t = .397$	$A_{br} = .657 \times .397 = .261$
	$A_t = (2.14 - .657).397 = .589$

$K_{br} = 1.6$

$K_t = .91$

$P_{bru} = 1.6 \times 66,000 \times .261 = \underline{27500}$

$P_{tu} = .91 \times 66,000 \times .589 = \underline{35300}$

FORM 1319A

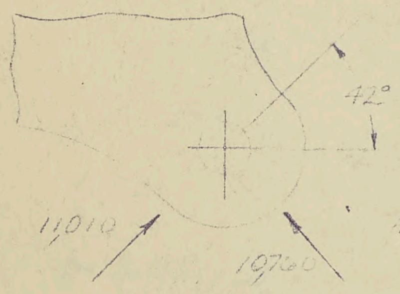
A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**	REPORT No.	
	SHEET No. 2.25	
AIRCRAFT: C-105	PREPARED BY: McCABE	DATE: 11-30-55
	CHECKED BY:	DATE:

DIAPHRAGMS

STA. 693.11 DIAPHRAGM

LUGS

TRANSVERSE & AXIAL COMPRESSION LOADS



$$\text{TRANSVERSE LOAD} = (14150+1250)\,\text{SIN}\,42^\circ + 950\,\text{COS}\,42^\circ$$
$$= 10300 + 710$$
$$= \underline{11,010\ \text{LBS.}}$$

$$\text{AXIAL LOAD} = (14150+1250)\,\text{COS}\,42^\circ - 950\,\text{SIN}\,42^\circ$$
$$= 11,400 - 640$$
$$= \underline{10,760\ \text{LBS.}}\ \text{(COMPRESSION)}$$

MARGIN OF SAFETY

CRITICAL MARGIN OF SAFETY IS FOR COMBINED AXIAL TENSION & TRANSVERSE LOADS.

$$R_A = \frac{8970}{27,500} = .33$$

$$R_T = \frac{9340}{20,800} = .45$$

$$M.S. = \frac{1}{(R_A^{1.6} + R_T^{1.6})^{.625}} - 1.$$

$$= \frac{1}{(.33^{1.6} + .45^{1.6})^{.625}} - 1 = \underline{.56\ M.S.}$$

DIAPHRAGM ATTACHMENT TO ELEV. JACK FITTING

REF. 7/0562/26, PG. 19

DIAPHRAGM FLANGE ATTACHMENT TO HORIZ. PLATES

REF. PG. 3.33

FORM 1319 A

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

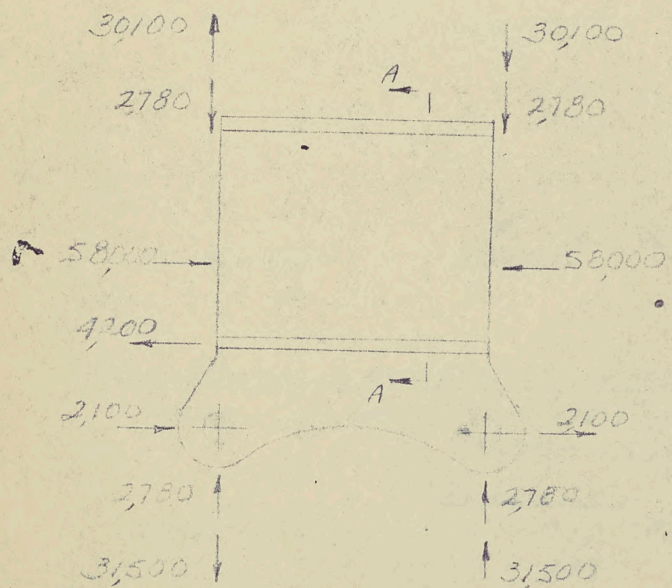
AIRCRAFT:		REPORT No.	
C-105		SHEET No.	2.26
		PREPARED BY	DATE
		McCABE	11-29-55
		CHECKED BY	DATE

DIAPHRAGMS

STA. 639.31 DIAPHRAGM

FUS. STRUT & ELEV. JACK LOADS

LOADS, REF PGS. 2.21 & 2.22

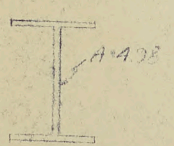


WEB STRESS

WEB SHEAR = 30,100 + 2,780 = 32,880 LBS.

$f_s = \frac{32,880}{5.0 \times .50} \doteq 13,200$ PSI.

END LOAD = 58,000 PSI.



$f_c = \frac{58,000}{4.98} = 11,600$ PSI.

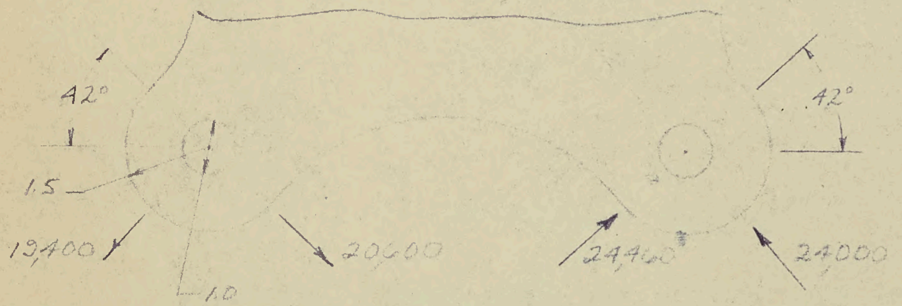
WEB STRESS NOT CRITICAL

FORM 1319A

DIAPHRAGMS

STA. 699.31 DIAPHRAGM

LUGS



TRANSVERSE & AXIAL TENSION LOADS (LEFT)

TRANSVERSE LOAD = (31,500 − 2,780) SIN 42° + 2100 COS 42°
= 19200 + 1560
= 20600 LBS.

AXIAL LOAD = (31,500 − 2,780) COS 42° − 2100 SIN 42°
= 21,300 − 1400
= 19,400 LBS.

TRANSVERSE & AXIAL COMPRESSION LOADS (RIGHT)

TRANSVERSE LOAD = (31,500 + 2,780) SIN 42° + 2100 COS 42°
= 22,900 + 1560
= 24460 LBS.

AXIAL LOAD (31,500 + 2,780) COS 42° − 2100 SIN 42°
= 25,400 − 1400
= 24000 LBS.

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO.	2.28
		PREPARED BY	DATE
		McCABE	12-1-55
		CHECKED BY	DATE

DIAPHRAGMS

STA 693.11 DIAPHRAGM

LUGS

ALLOWABLE TRANSVERSE LOAD (REF. LUG ANALYSIS, 20230-E)

$A_{AV} = A_{br} = .90 \times 1.0 = .90$

$\frac{A_{AV}}{A_{br}} = 1.0$

$K_{try} = 1.05$

$P_{tu} = 1.05 \times .90 \times 66{,}000 = \underline{62200^{\#}}$

ALLOWABLE AXIAL LOAD (REF. LUG ANALYSIS, 20230-E)

$a = 1.5 \qquad a/D = 1.5/1.0 = 1.5$

$D = 1.0 \qquad w/D = 3.0/1.0 = 3.0$

$w = 3.0 \qquad D/t = 1.0/.90 = 1.11$

$t = .90 \qquad A_{br} = 1.0 \times .90 = .90$

$A_t = (3.0 - 1.0).90 = 1.80$

$K_{br} = 1.45$

$K_t = .92$

$P_{bru} = 1.45 \times .90 \times 66{,}000 = \underline{86000 \text{ LBS.}}$

$P_{tu} = .92 \times 1.8 \times 66{,}000 = \underline{109{,}000 \text{ LBS.}}$

MARGIN OF SAFETY

CRITICAL MARGIN IS FOR COMBINED AXIAL TENSION & TRANSVERSE LOADS

$R_A = 13{,}900 / 86{,}000 = .23$

$R_T = 20{,}600 / 62{,}200 = .33$

$$M.S. = \frac{1}{(R_A^{1.6} + R_T^{1.6})^{.625}} - 1$$

$$= \frac{1}{(.23^{1.6} + .33^{1.6})^{.625}} - 1 = \qquad \underline{1.28 \text{ M.S.}}$$

DIAPHRAGM ATTACHMENT TO ELEV. JACK FITTING

REF. 7/0502/26, PGS. 16 & 17

DIAPHRAGM ATTACHMENT TO HORIZ. PLATES

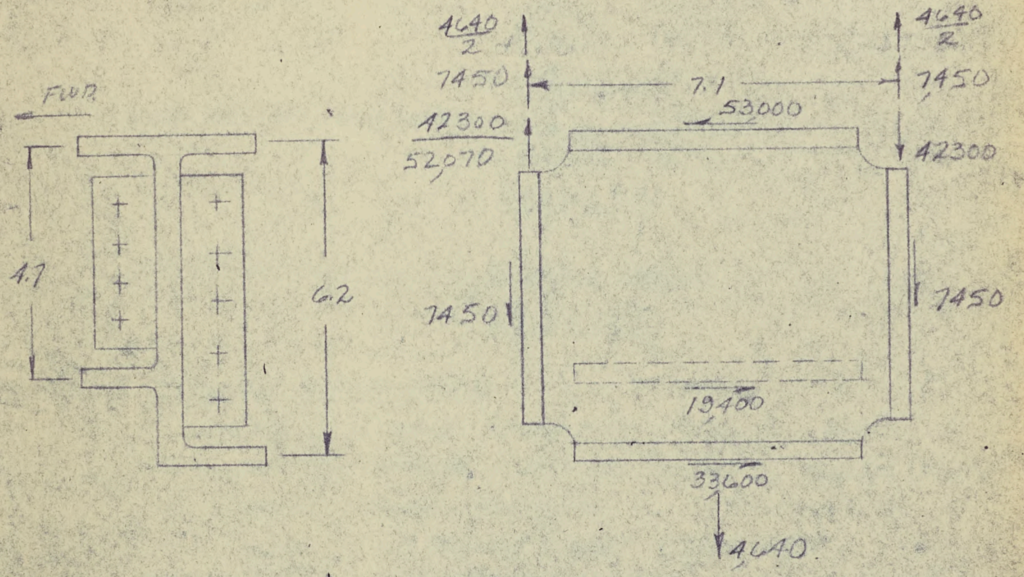
REF. PGS. 3.30 & 3.31

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No.	2.23
PREPARED BY	McCABE
DATE	7-18-55
CHECKED BY	
DATE	

AIRCRAFT: C-105

DIAPHRAGMS
STA. 711.92



CRITICAL CASE IS R.P.O.
LOADS ON DIAPHRAGM ARE FROM FIN SKIN DIFFERENTIAL LOADS, BEAM #1 INERTIA & ENGINE LOADS, & STA. 714.85 STRUT PICKUP FITTING.

DIAPH. SHEAR FROM FIN SKIN LOADS = 42,300# (PG. 2.03)
LOAD FROM BEAM #1 = .62 x 12000 = 7450# (REF. DOSS) X
LOAD FROM STA 714.85 FITTING = 4640# (PG. 5.11)

MOMENT FROM FIN SKIN LOAD = 7.1 x 42,300
= 300,000 IN. LBS.

MOMENT IS REACTED BY COUPLE LOADS IN UPPER & LWR. SURFACES. DUE TO JOGGLE IN LOWER FLANGE, ASSUME PART OF MOMENT REACTED BY FWD. & AFT FLANGES TO BE IN PROPORTION TO THE CUBE OF THEIR RESPECTIVE DISTANCES FROM UPPER FLANGE.

Engine loads from Beam #2 = 12000# — 62% to Diaph I
38% to II
(SEE BEAM 1-2 ANALYSIS)

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	
REPORT NO.	
SHEET NO.	2.30
PREPARED BY	McCABE
DATE	7-18-55
CHECKED BY	
DATE	

DIAPHRAGMS
STA. 711.32

LOAD IN FWD. FLG. LWR. $= \frac{4.7^3}{4.7^3+6.2^3} \times \frac{284000}{4.7}$

$= \underline{19400 \text{ LBS.}}$

LOAD IN AFT FLG. LWR. $\frac{6.2^3}{(4.7^3+6.2^3)} \times \frac{284000}{6.2}$

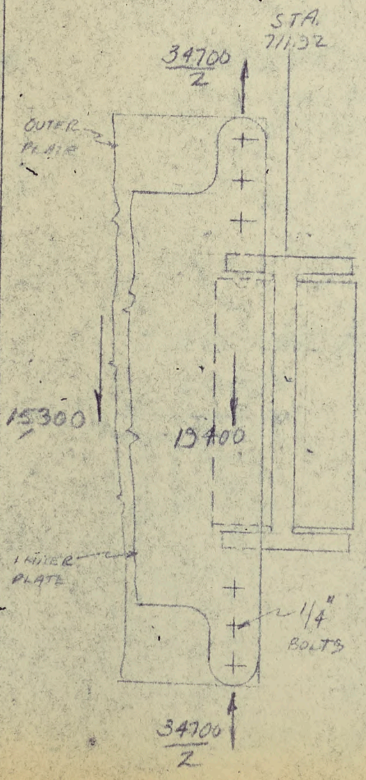
$= \underline{33600 \text{ LBS.}}$

UPPER FLANGE LOAD $= 33600 + 19400$

$= \underline{53000 \text{ LBS.}}$

FLANGE LOWER - FWD.

LOAD IN LOWER FORWARD FLANGE IS REACTED BY INNER & OUTER PLATES. THESE PLATES ALSO CARRY ELEV. JACK LOAD.



FLANGE LOAD = 18400 LBS.

SHEAR IN PLATES FROM ELEV. JACK = 15300# (PG. 3.29)

LOADS IN PLATES ARE REACTED BY 6 - 1/4" BOLTS

LOAD ON BOLTS = 15300 + 19400

= 34700 LBS.

ALLOW. LOAD = 6 × 9,300 = 55800 LBS.

$$M.S. = \frac{55800}{34700} - 1 = \quad \underline{.61 \ M.S.}$$

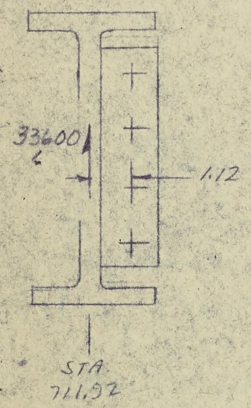
FORM 1318A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No.	2.31
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	7-19-55
CHECKED BY	
DATE	

DIAPHRAGMS
STA. 711.92
LOWER AFT FLANGE



SHEAR LOAD ON ATTACHMENTS = 33,600# (2.30)

MOMENT = 1.12 × 33,600 = 37,600 IN.LBS

I_P = 10.3

LOAD ON CRITICAL BOLT FROM MOMENT = $\frac{37600 \times 2.15}{10.3}$

= 7850 LBS

LOAD PER BOLT FROM SHEAR = 33600/4 = 8400

TENSION LOAD ON TWO INNER BOLTS = 4640/2 = 2320#

OUTER BOLTS CRITICAL

RESULT SHEAR = $(7850^2 + 8400^2)^{1/2}$ = 11,500 LBS.

ALLOW. LOAD = 13,200 LBS.

M.S. = $\frac{13200}{11,500} - 1$ = .15 M.S.

FLANGE SHEAR

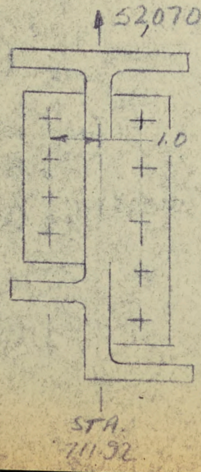
SHEAR = 33600 LBS. (PG. 2.30)

f_s (WET) = $\frac{33600}{5.5 \times .31} \times \frac{3}{2}$ = 29,600 PSI.

F_s = 45,000 PSI.

M.S. = $\frac{45,000}{29,600} - 1$ = .52 M.S.

ATTACHMENT TO VERT. PLATES



LOAD ON FWD. ATTACHMENTS = 52,070/2

= 26,035

LOAD PER BOLT = $\frac{26,035}{4}$ = 6,500#

ALLOW. LOAD = 9,300#

M.S. = $\frac{9300}{6,500} - 1$ = .43 M.S.

WEB STRESS

$f_s = \frac{52070}{4.9 \times .50} \times \frac{3}{2}$ = 31,800 PSI.

M.S. = $\frac{45,000}{31,800} - 1$ = .41 M.S.

FORM 1319A

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

REPORT No.
SHEET No. 3.01

AIRCRAFT: C-105

PREPARED BY	DATE
McCABE	
CHECKED BY	DATE

PART III – FIN BOX HORIZ. PLATES

FORM 1319A

FIN BOX HORIZ. PLATES

DESCRIPTION

THE ANALYSIS OF THE UPPER & LOWER SURFACE PLATES IS PRESENTED IN THREE PARTS. SEC. 1 DEALS WITH ALL PLATES BETWEEN STA. 607.63 & STA. 681.37. CRITICAL LOADS FOR THESE PLATES ARE FROM SYMM. FLT. CASE. SEC. 2 COVERS ALL PLATES BETWEEN STA. 681.37 & STA. 742.5. CRITICAL LOADS ARE FROM R.P.O. CASE, & WHERE APPLICABLE, ELEV. JACK LOADS. SEC. 3 CONSIDERS THE EFFECT OF THE INDUCED ECCENTRICITY DUE TO THE BEND IN UPPER & LWR. SURFACE PLATES.

A DIAGRAM INDICATING PLATE SIZES & LOCATIONS IS INCLUDED ON PG. 3.03.

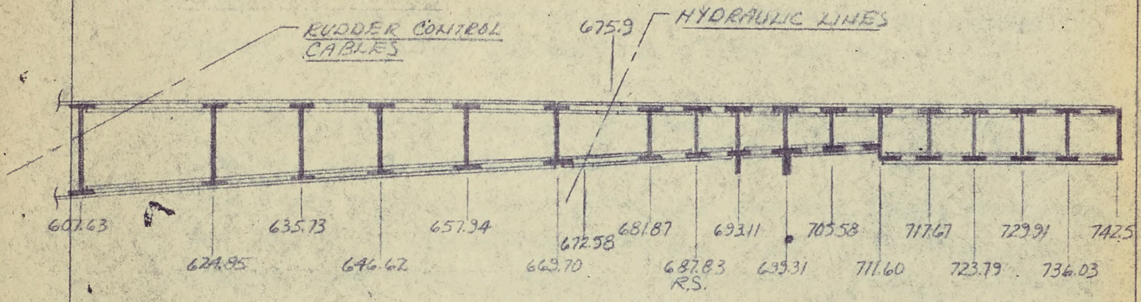
AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.
SHEET No. 3.03

AIRCRAFT: C-105

PREPARED BY	DATE
McCABE	7-12-55
CHECKED BY	DATE
R. J. Sleacy	

DIAGRAM - LOCATION & SIZES - HORIZ. PLATES



PROFILE OF FINBOX STA. 607.63-742.5

FINBOX SPLICE PLATES - UPPER & LOWER SURFACES STA. 607.63 - STA. 742.50

STA. TO STA.	UPPER SURFACE		LOWER SURFACE	
	INNER	OUTER	INNER	OUTER
607.63 — 624.85	.204	.204	.125	.188
624.85 — 635.73				
635.73 — 646.62				
646.62 — 657.94				
657.94 — 669.70		.204	.125	.188
669.70 — 681.87		.250 †	.204	.204
681.87 — 687.83	.204		.204	.204
687.83 — 693.11	.250		.204	.204
693.11 — 699.31	.188		.188	.188
699.31 — 705.58	*			
705.58 — 711.60	*			
711.60 — 717.67	*			
717.67 — 723.79	*		*	
723.79 — 729.91			*	
729.91 — 736.03			*	
736.03 — 742.50	.188	.250	.188 *	.188

NOTE: ALL PLATES ARE 75S-T6

* LIGHTENING HOLE

†

FORM 1318A

SEC. 1 — UPPER & LWR. SURFACE PLATES — STA 607.63 - STA 681.87

THE FOLLOWING ANALYSIS COVERS UPPER & LOWER PLATES BETWEEN STA. 607.63 & STA. 681.87

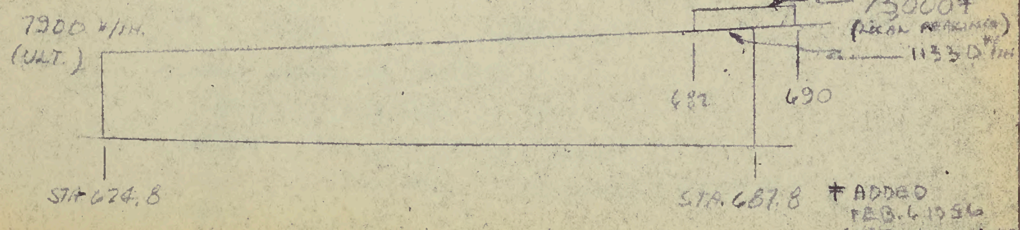
LOWER SURFACE INNER ~~& OUTER~~ PLATES BETWEEN STA. 607.63 & STA. 669.7 ARE .125 75S-T6. A 1.0" WIDE STRIP OF MAGNESIUM ATTACHED BETWEEN INNER & OUTER PLATES WILL BE USED TO DECREASE PANEL SIZE IN ORDER TO RAISE THE PANEL CRITICAL BUCKLING STRESS. ANALYSIS OF INNER PLATE BETWEEN STA. 657.94 & STA. 669.70 SUBSTANTIATES STRENGTH OF ALL LOWER SURFACE PLATES BETWEEN STA. 607.63 & STA. 669.70.

UPPER SURFACE INNER & OUTER PLATES BETWEEN STA. 624.85 & STA. 669.70 ARE BASICALLY .204 THICK, BUT ARE MACHINED DOWN TO .14 (NOMINAL)* IN AREA WHERE NET SECTION IS NOT CRITICAL. AS IN LOWER SURFACE PLATES, A MAGNESIUM STRIP IS BEING USED TO INCREASE THE PANEL CRITICAL BUCKLING STRESS. ANALYSIS OF INNER PLATE BETWEEN STA. 657.94 & STA. 669.70 SUBSTANTIATES STRENGTH OF ALL UPPER SURFACE PLATES BETWEEN STA. 624.85 & STA. 669.70.

A SEPARATE ANALYSIS CONSIDERING THE EFFECTS OF ACCESS HOLES IN PLATES BETWEEN STA. 607 & STA. 624.85 (UPPER) AND STA. 669.70 & STA. 681.87 (UPPER & LOWER) IS INCLUDED.

WING SKIN END LOAD

UPPER SURFACE COMPRESSION & LOWER SURFACE TENSION



+ ADDED FEB. 6 1956 (REF WING GROUP)

NOTE: UPPER SURFACE TENSION & LOWER SURFACE COMPRESSION ARE 50% OF ABOVE LOADS

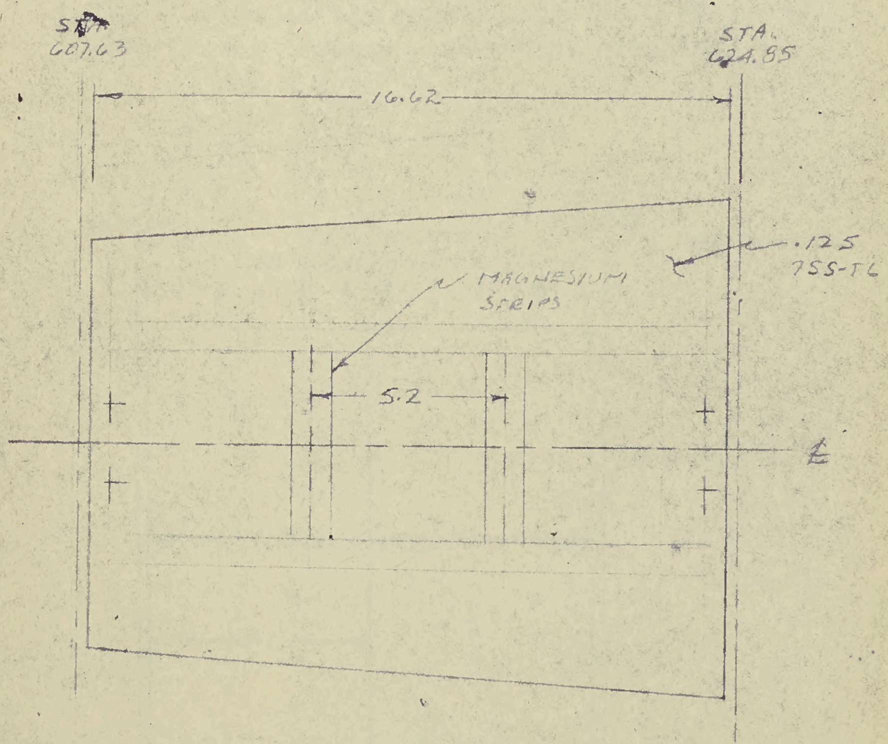
*NOTE: SUBSEQUENT ACTION ELIMINATED MACHINED RECESS IN PLATES AND RESTORED THEM TO THE ORIGINAL UNIFORM .204 THICKNESS (12-1-55)

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No.	3.05
PREPARED BY	DATE
McCABE	7-12-55
CHECKED BY	DATE

AIRCRAFT: C-105

LOWER SURFACE SPLICE PLATE—INNER STA. 607.63—STA. 624.85



LWR. SURFACE SKIN LOAD STA. 624.85

TENSION = 7,900 #/IN. (PG 3.04)

COMPRESSION = 7900/2 = 3,950 #/IN.

COMPRESSION

LOAD PER IN. ON PLATE = $\frac{3950}{2} \times \frac{17.22}{16.62}$ = 2050 #/IN.

f_c = 2050 / .125 = 16,400 PSI.

ALLOW. BUCKLING STRESS

$\sqrt{K}$ = 1.9 , b = 5.2

$(b/t)_e$ = 5.2 / .125 × 1.9 = 21.9

F_{cr} = 21000 PSI. (LOCKHEED SM. 33b)

M.S. = $\frac{21000}{16400}$ − 1 = .28 M.S.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

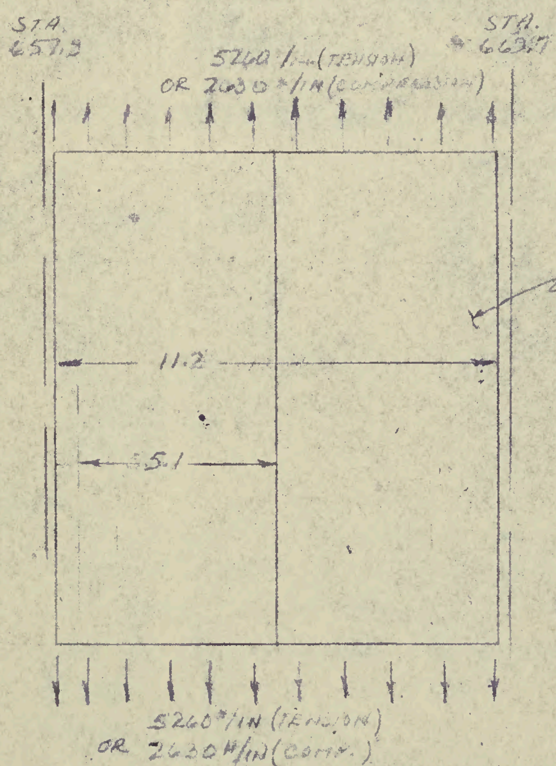
AIRCRAFT:		REPORT No.	
C-105		SHEET No.	3.06
		PREPARED BY	DATE
		McCABE	6-6-55
		CHECKED BY	DATE

LOWER SURFACE SPLICE PLATE — INNER - STA. 657.9 - STA. 663.7

WING LOWER SURFACE END LOADS

MAX. TENSION STA. 663 = 10000 #/IN (PG 3.04)

MAX. COMPRESSION = 10000/2 = 5000 #/IN.



REF. DWG. 7-1062-323

MAX. TENSION LOAD ON PLATE = $\frac{10,000}{2} \times \frac{11.8}{11.2} = 5260$ #/IN.

MAX. COMPRESSION LOAD = $\frac{5000}{2} \times \frac{11.8}{11.2} = 2630$ #/IN.

TENSION STRESS

TENSION LOAD PER IN. = 5260 #/IN.

FOR 1/4" LOCK BOLTS @ 1 IN 5 IN (AVG.), TENSION EFFICIENCY

FACTOR = $1 - \frac{.25}{1.15} = .782$

$f_t = \frac{5260}{.125 \times .782} = 54000$ PSI.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No	3.07
PREPARED BY	McCABE
DATE	6-6-55
CHECKED BY	
DATE	

AIRCRAFT: C-105

LOWER SURFACE SPLICE PLATE - INNER STA. 657.9 - STA. 669.7

TENSION STRESS

$F_t = .93 \times 72{,}000 = 67{,}000$ PSI.

$M.S. = \frac{67{,}000}{54{,}000} - 1 =$ **.24 M.S.**

COMPRESSION STRESS

COMPRESSION LOAD PER IN. = 2630 #/IN. (PG. 3.06)

$f_c = \frac{2630}{.125} = 21000$ PSI

ALLOWABLE BUCKLING STRESS (REF LOCKHEED SM 336).

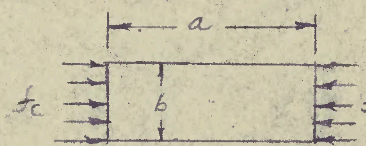
$a = 7.2$

$b = 5.1$

$b/a = 5.1/7.2 = .71$

$\sqrt{K} = 1.90$

$(b/t)_e = \frac{5.1}{.125 \times 1.9} = 21.5$



$F_{cc} = 22{,}000$ PSI

$M.S. = \frac{22{,}000}{21{,}600} - 1 =$ **.02 M.S.**

ATTACHMENTS

MAX. LOAD ON PLATE = 11.4 x 5,260 = 60,000 LBS. (PG 3.06)

ALLOW. LOAD 1/4" LOCK BOLT IN .125 = 4280#

ATTACHMENT IS BY 19 - 1/4" LOCKBOLTS

ALLOWABLE LOAD = 19 x 4280 = 81,500 LBS.

$M.S. = \frac{81500}{60{,}000} - 1 =$ **.36 M.S.**

FORM 1319A

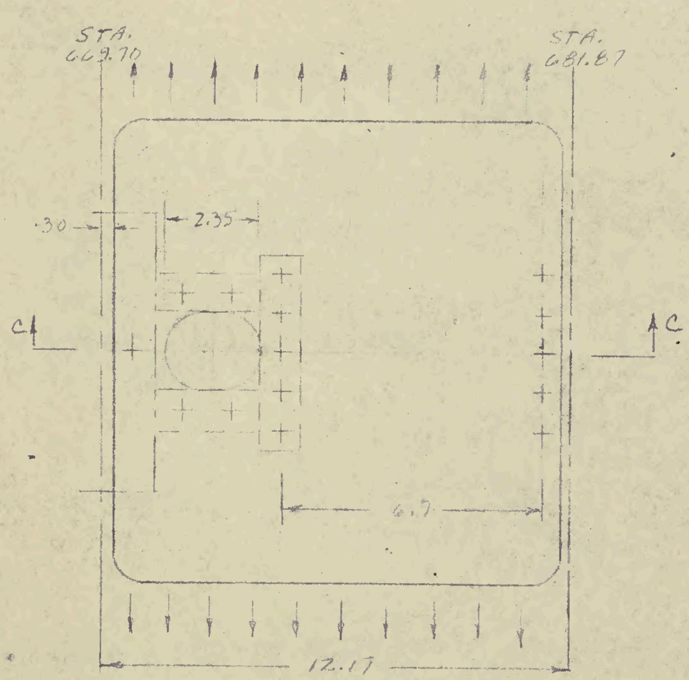
AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No	
SHEET No	3.08
PREPARED BY	McCABE
DATE	7-12-55
CHECKED BY	
DATE	

AIRCRAFT: C-105

LOWER SURFACE SPLICE PLATE - INNER (STA. 669.7 - STA. 681.87)



AVG. LOWER SURFACE LOAD STA. 669.7 - STA. 681.87

TENSION = 10,700 #/IN
COMPRESSION = 5,350 #/IN
} PG 3.04

SEC. C-C

TENSION

NET TENSION LOAD ON PLATE $\frac{10700 \times 12.17}{2(12.17-3.7)} = 7700$ #/IN.

$ft = \frac{7700}{.20} = 38{,}500$ PSI.

$Ft = .93 \times 72{,}000 = 67{,}000$ PSI.

$M.S. = \frac{67000}{38500} - 1 =$ .74 M.S.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No.	3.09
PREPARED BY	DATE
McCABE	7-12-55
CHECKED BY	DATE

AIRCRAFT: C-105

LOWER SURFACE SPLICE PLATE - INNER (STA. 663.7 - STA. 681.87)

SEC. C-C

COMPRESSION

NET COMPRESSION LOAD ON PLATE $= \frac{5350 \times 12.17}{2(12.17 - 2.95)} = 3530$ #/IN.

$\therefore f_c = \frac{3530}{.20} = 17{,}700$ PSI.

ALLOW BUCKLING STRESS (LOCKHEED SM 336)

$K = 1.9$

$b = 6.7$

$(b/t)_e = 6.7/.20 \times 1.9 = 17.6$

$F_{cc} = 34{,}000$

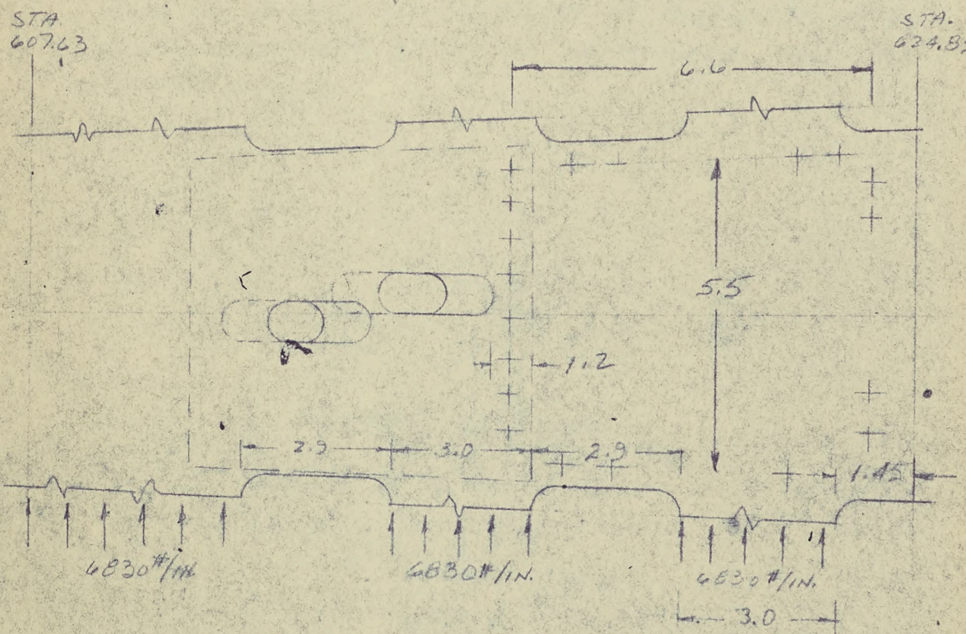
$M.S. = \frac{34000}{17700} - 1$ $\qquad$ .92 M.S.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105		REPORT No.	
		SHEET No. 3.10	
		PREPARED BY	DATE
		McCABE	7-25-55
		CHECKED BY	DATE

UPPER SURFACE SPLICE PLATE ~ OUTER (STA.607.63 - STA.624.85)



MAX. UPPER SURFACE END LOAD = 7,900 #/IN. (PG. 3.04)

NET END LOAD @ SLOTS $= \frac{17.22}{997} \times \frac{7900}{2} = 6830$ #/IN.

$f_c = \frac{6830}{.204} = 33{,}500$ PSI

$F_c = .93 \times 72{,}000 = 67{,}000$ PSI

M.S. $= \frac{67{,}000}{33{,}500} - 1 =$ 1.00 M.S.

FORM 1319A

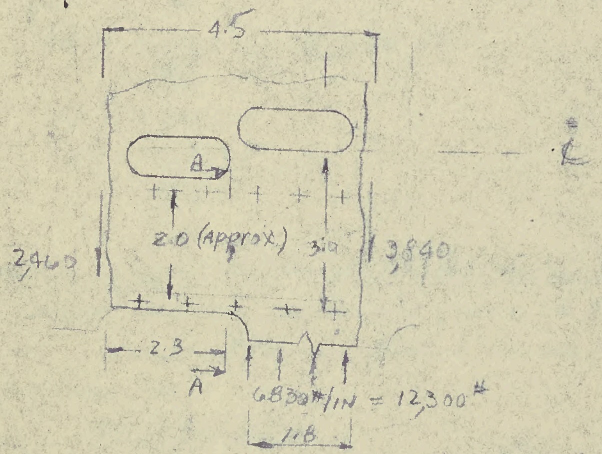
AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO. 3.11	
		PREPARED BY	DATE
		McCABE	7-25-55
		CHECKED BY	DATE

UPPER SURFACE SPLICE PLATE ~ OUTER (STA. 607.43 – STA. 624.95)

ASSUME END LOAD IN PLATE IS DIVERTED AROUND SLOTS IN CENTER OF PLATE IN MANNER SHOWN IN SKETCH BELOW.



ASSUME MAXIMUM END STRESS & SHEAR STRESS COMBINE.

$f_c = 6830/.204 = 33{,}500$ PSI.

ALLOW. COMPRESSIVE STRESS

AS A COLUMN; $\rho = .289 \times .204 = .059$, $L = 2.0$, $C = 4.0$

$\frac{L'}{\rho} = \frac{2.0}{2 \times .059} = 17$

$F_c = 67{,}000$ PSI.

$R_c = 33{,}500/67{,}000 = .50$

$f_s = \frac{3840}{3.0 \times .204} = \underline{16000 \text{ PSI}}$

$F_s = 44{,}000$ PSI

$R_s = 16{,}000/44{,}000 = .36$

MARGIN OF SAFETY

$R_s^2 + R_c = 1$

M.S. = $\underline{.44 \text{ M.S.}}$

FORM 1318A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No	3.12
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	7-25-55
CHECKED BY	
DATE	

UPPER SURFACE SPLICE PLATE — OUTER (STA. 607.63 – STA. 624.85)

BENDING SEC. A-A (PG. 3.11)

MOMENT = 2.3 × 2460 = 5,660

$I/c = \frac{2.0^2 \times .204}{6} = .136$

$f_b = \frac{5,660}{.136} = 41,600$ PSI.

$F_t = 67,000$

$M.S. = \frac{67,000}{41,600} - 1 =$ .61 M.S.

PANEL SHEAR & COMPRESSION BUCKLING

CHECK PANEL BETWEEN STA. 624.85 & AND MAGNESIUM PACKING FOR COMBINED COMPRESSION & SHEAR

COMPRESSION

COMPRESSION LOAD = 6830 (3+1.2) (REF. PG. 3.10)
= 28,300 LBS.

$f_c = \frac{28300}{6.6 \times .204} = 21400$ PSI.

ALLOW. COMPRESSION STRESS (LOCKHEED SM 336)

$b = 6.6$, $\sqrt{K} = 1.9$

$(b/t)_e = 6.6 / 1.9 \times .204 = 17$

$F_{cc} = 34000$ PSI.

SHEAR

SHEAR STRESS = 16,000 PSI. (REF. PG. 3.11)

ALLOW. SHEAR STRESS (LOCKHEED SM 336)

$b = 5.5$, $\sqrt{K} = 2.2$

$(b/t)_e = 5.5 / 2.2 \times .204 = 12.2$

$F_{cc} = 35,000$ PSI.

MARGIN OF SAFETY

$R_c = 21,400 / 34,000 = .63$

$R_s = 16,000 / 35,000 = .46$

$R_s^2 + R_c = 1$

M.S. = .12 M.S.

OBM 1319A

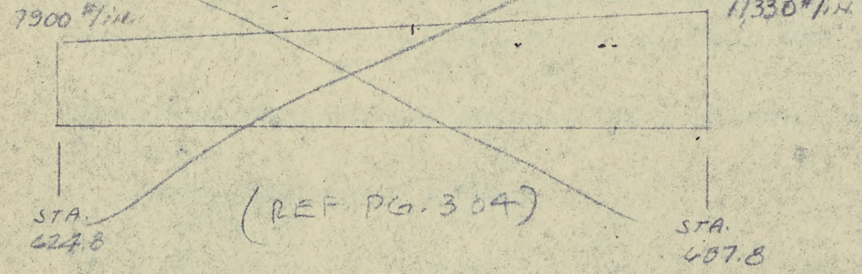
AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

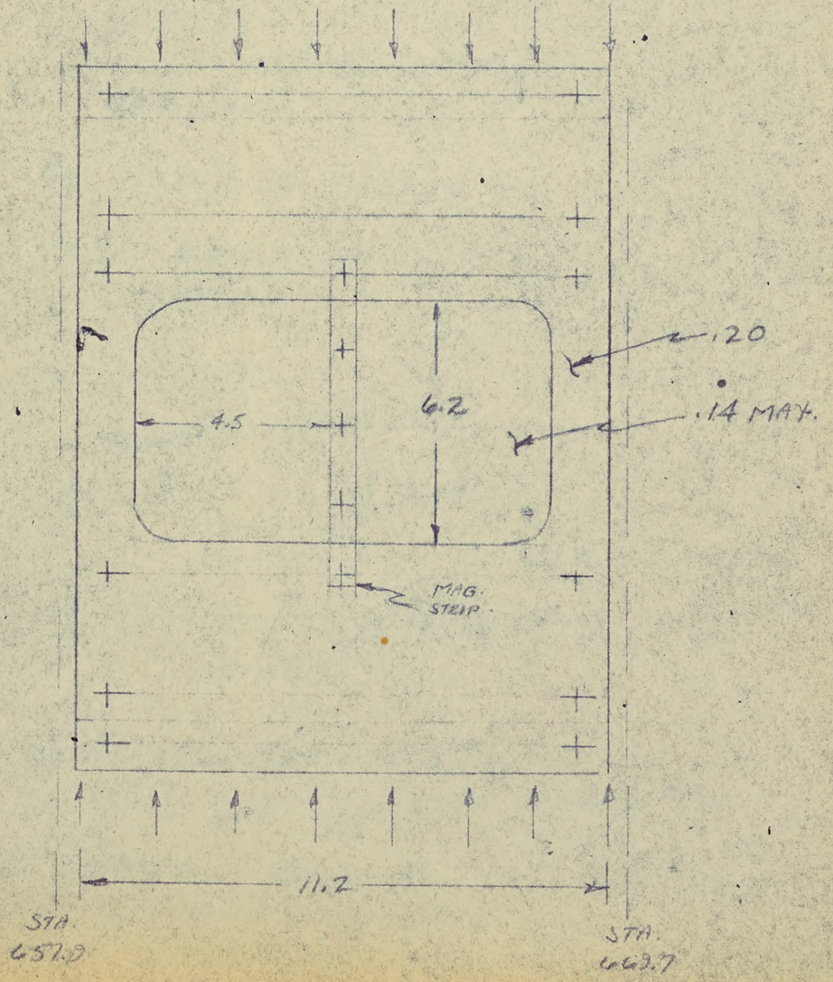
REPORT No.	
SHEET No.	3.13
PREPARED BY	McCABE
DATE	6-7-55
CHECKED BY	
DATE	

AIRCRAFT: C-105

UPPER SURFACE SPLICE PLATE — INNER — STA 657.9 - STA 663.7

~~MAX. LOAD PER IN. - WING UPPER SURFACE~~





FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105		REPORT NO.	
		SHEET NO. 3.14	
		PREPARED BY: McCABE	DATE: 6-7-55
		CHECKED BY	DATE

UPPER SURFACE SPLICE PLATE - INNER - STA 657.9 - STA 669.7

AVERAGE WING SKIN LOAD STA. 657 - 669.7 = 10,000 #/IN. (PG 3.04)

LOAD PER IN ON PLATE = $\frac{11.8}{11.2} \times \frac{10,000}{2}$ = 5260 #/IN.

PANEL THICKNESS IS MACHINED FROM .20 TO .14 MAX. AT CENTER.

ALLOW. BUCKLING STRESS

$a = 6.1$

$b = 4.2$

$t = .135$ (.14 NOMINAL)

$\sqrt{R} = 1.9$

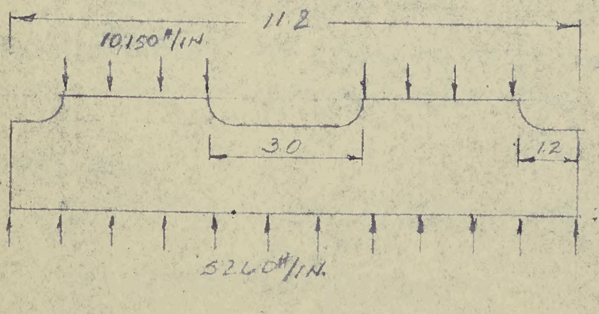
$(b/t)_e = 4.5/.135 \times 1.9 = 17.5$

$F_{cr} = 34,000$

$f_c = 4520/.135 = 33,500$ PSI.

$M.S. = \frac{34,000}{33,500} - 1$ .01 M.S.

NET SECTION



LOAD PER IN. ON PLATE = 5260 #/IN.

NET LOAD AT SLOTS = $\frac{11.2}{5.8} \cdot 5260$ = 10150 #/IN.

$f_c = 10150/.20 = 51,000$ PSI

$F_c = .93 \times 72,000 = 67,000$ PSI.

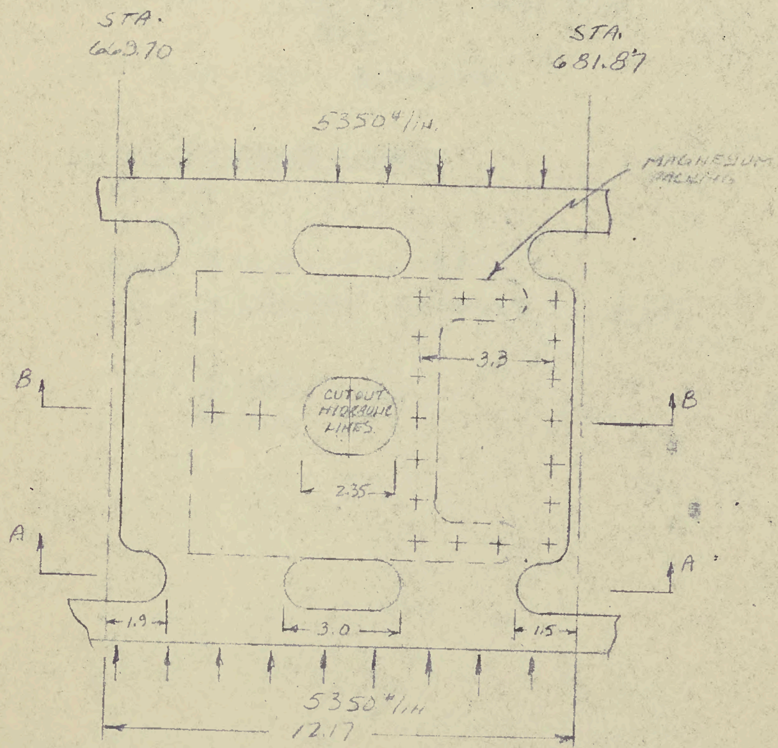
$M.S. = \frac{67,000}{51,000} - 1 =$ .31 M.S.

FORM 1318A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	3.15
		PREPARED BY	DATE
		McCABE	7-12-55
		CHECKED BY	DATE

UPPER SURFACE SPLICE PLATE - INNER (STA. 669.7 - STA. 681.87)



AVG. UPPER SURFACE LOAD STA. 669.7-681.87 = 10,700 #/IN COMPRESSION (PG. 3.04)
LOAD ON PLATE = 10,700/2 = 5,350 #/IN.

SEC. A-A

NET LOAD = $\frac{5350 \times 12.17}{5.77}$ = 11,300 #/IN.²

fc = 11,300/.20 = 56,500 PSI.
Fc = .93 × 72,000 = 67,000 PSI.

M.S. = $\frac{67,000}{56,500}$ − 1 = .19 M.S.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO	
SHEET NO	3.16

AIRCRAFT		PREPARED BY	DATE
C-105		MC CABE	7-12-55
		CHECKED BY	DATE

UPPER SURFACE SPLICE PLATE - INNER (STA. 669.7 - STA. 681.87)

CUTOUT FOR HYDRAULIC LINES

SEC B-B

NET LOAD $= \dfrac{5350 \times 12.17}{9.12} = 7130$ #/IN.

$f_c = 7130/.20 = 35700$ PSI.

ALLOW. BUCKLING STRESS

$\sqrt{K} = 1.9$

$b = 3.3$

$(b/t)_e = 3.3/.20 \times 1.9 = 8.7$

$F_{cr} = 59000$ PSI (LOCKHEED SM 336)

$M.S. = \dfrac{59000}{35700} - 1 =$ .65 M.S.

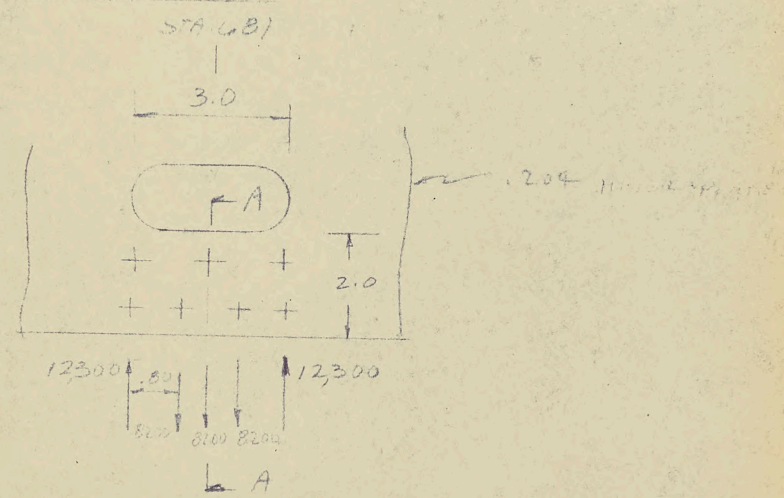
FORM 1319A

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

REPORT No.
SHEET No. 3.161

AIRCRAFT:		PREPARED BY	DATE
C-105		MCCABE	
		CHECKED BY	DATE

UPPER SURFACE SPLICE PLATE ~ INNER (STA. 669.7 - STA. 681.87)
BENDING AT SLOT IN PLATE



UPPER SURFACE END LOAD 11330#/IN. (PG. 304)
ATTACHMENT SPACING = 2 ROWS 1/4" @ 1.45 IN. C.C.
LOAD/ATTACH. = $\frac{1.45 \times 11330}{2}$ = 8,200#

SIMPLE MOMENT (A-A) = (12300 × 1.5 − .70 × 8200)
= 18,400 − 5700 = 12,700 IN.LBS.
MOMENT/PLATE = 12700/2 = 6350 IN.#
I/c (A-A) = $\frac{.204 \times 2.0^2}{6}$ = .136

f_b = 6350/.136 = 46,600 PSI
F_t = 67000
M.S. = $\frac{67{,}000}{46{,}600}$ − 1 = .44 M.S.

ATTACHMENT TO WING SKIN (STA. 607 - STA. 681)
MAX. LOAD/ATTACH. = 8200#
ALLOW. LOAD 1/4" LOCKBOLT = 9,300#
M.S. = $\frac{9300}{8200}$ − 1 = .13 M.S.

FORM 1319A

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

REPORT No.		
SHEET No. 3.17		
AIRCRAFT: C-105	PREPARED BY: McCABE	DATE
	CHECKED BY	DATE

SEC. 2 ~ UPPER & LWR. SURFACE PLATES ~ STA. 631.87 - STA 742.5

THE FOLLOWING ANALYSIS COVERS UPPER & LWR. PLATES BETWEEN STA. 631.87 - STA. 742.5

SIZES OF PLATES ARE LISTED ON PG. 303. CRITICAL LOADING OCCURS FOR THE R.P.O. CASE.

THE ELEV. JACK LOADS ARE INCLUDED IN ANALYSIS OF PLATES BETWEEN STA 637.8 AND STA. 711.6. ONLY THE CRITICAL [illegible] PLATES ARE [illegible]; OTHER PLATES MAY BE CHECKED BY COMPARING TO THESE.

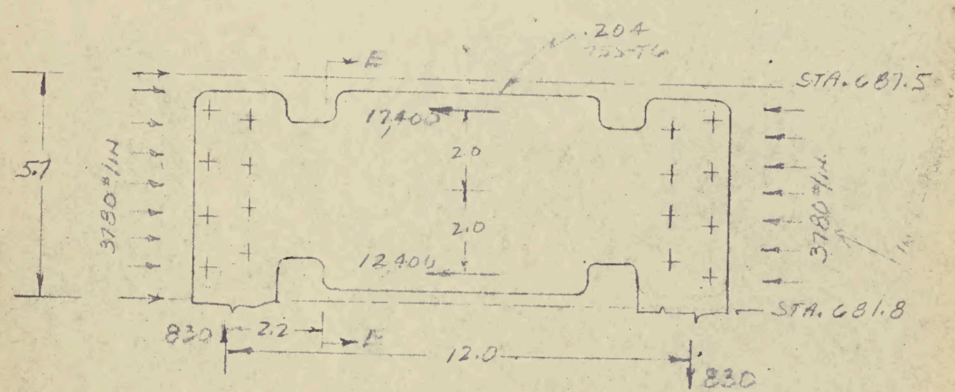
AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO
SHEET NO 3.18

AIRCRAFT: C-105

PREPARED BY: MCCABE | DATE: 7-8-55
CHECKED BY | DATE

UPPER SURFACE PLATES
INNER PLATE STA 681.81 - 687.83



CRITICAL CASE IS R.P.O.

SKIN END LOAD = $\frac{2}{3}$ SYMM. CASE = $\frac{2}{3}$ 11,330 = 7560 #/IN. (PG 3.14)

LOAD ON PLATE = $\frac{7560}{2}$ = 3,780 #/IN.

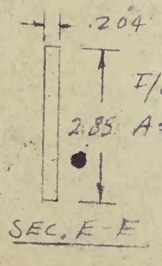
DIAPH. 687.5 LOAD = $\frac{63,500}{4}$ = 17,400 # (PG. 2.05)

DIAPH. 681.8 LOAD = $\frac{49,700}{4}$ = 12,000 # (PG. 2.05)

ASSUME MOMENT ON PLATE IS REACTED BY COUPLE LOADS AT ATTACHMENTS AS SHOWN IN SKETCH.

COUPLE LOADS = 2 (17,400 - 12,400) / 12 = 830 LBS.

SEC E-E STRESSES



MOMENT = 2.2 × 830 = 1,830 IN. LBS.
K = 1.5

ALLOW. MOMENT = 1.5 × 67,000 × .275 = 27,600 IN LBS.

END LOAD = 5.7 × 3780 + (17,400 + 12,400)/2 = 36,500 LBS.

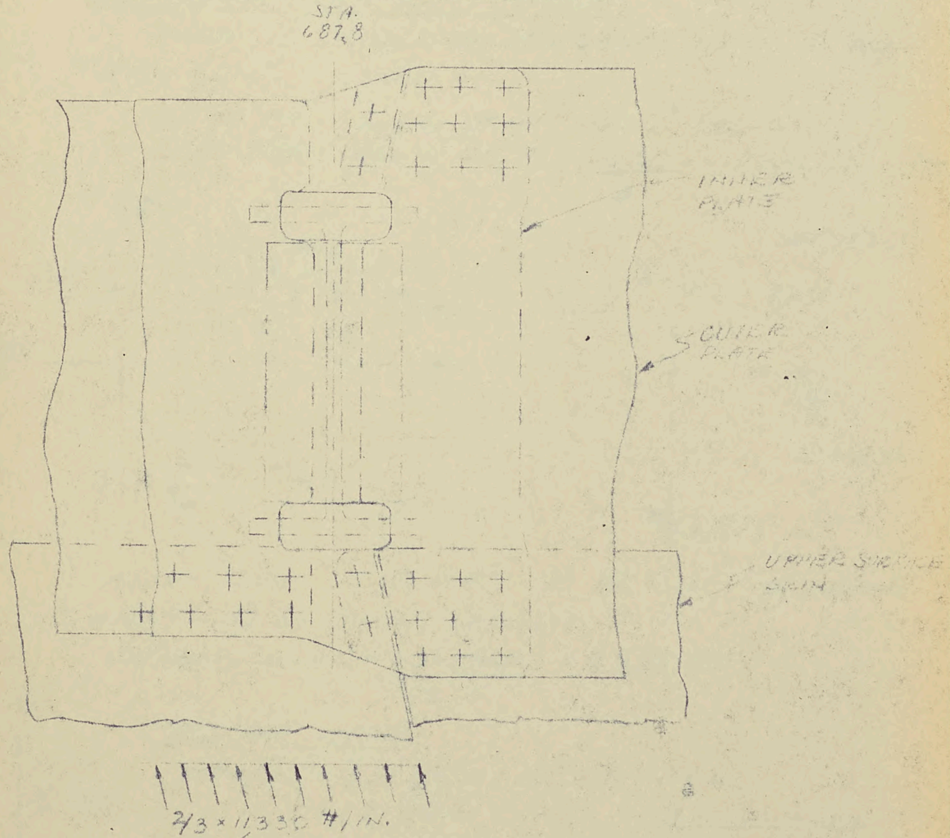
f_c = 36,500 / .58 = 63,000 PSI.

$R_B = \frac{1830}{27,600} = .06$; $R_C = \frac{63,000}{67,000} = .94$

M.S. = $\frac{1}{(.06 + .94)} - 1$ = .00 M.S.

FORM 1318A

UPPER SURFACE PLATES
INNER PLATES STA. 687.83 - STA. 711.6
STA 687.83 - STA 693.1 PLATE



CRITICAL LOADS ON INNER PLATE ARE FROM WING SKIN END LOAD @ STA. 687.83 DIVING CASE REQ.

WING SKIN END LOAD AT 687.83 = $\frac{2}{3} \times 11,330 = 7,550$ LBS. (P. 3.04)

TWO 5/16 ATTACHMENTS TO INNER PLATE ARE LOADED BY END LOAD.

WITH 2-ROWS 5/16 RIVETS @ 1.6 AV.

LOAD PER ATTACHMENT = $\frac{1.6 \times 7550}{2} = 6050^{\#}$ (DBL. SHEAR)

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

AIRCRAFT: C-105		REPORT NO.	
		SHEET NO. 3.20	
		PREPARED BY	DATE
		McCABE	12-5-55
		CHECKED BY	DATE

UPPER SURFACE PLATES

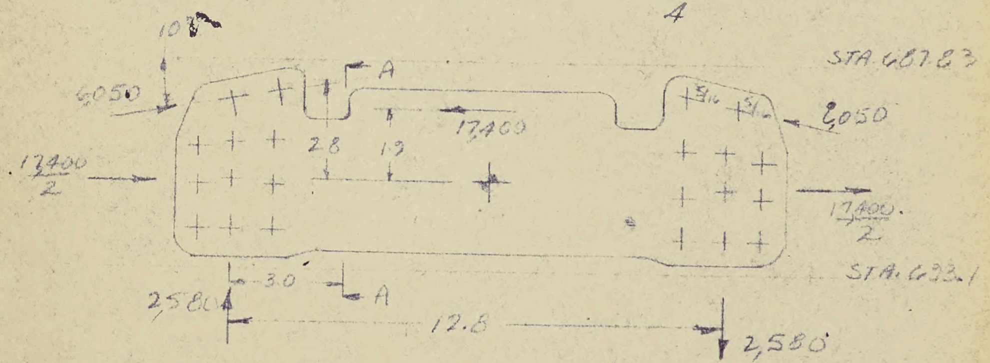
INNER PLATES. STA 687.83 – STA. 711.6

STA. 687.83 – STA. 693.1 PLATE

PLATE IS LOADED BY STA. 687.83 DIAPH. & BY WING SKIN END LOAD.

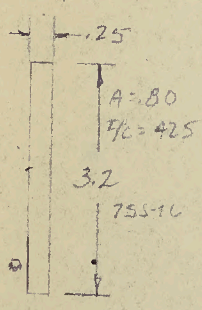
LOAD FROM WING SKIN = 6050# (PG 3.19)

LOAD FROM DIAPH. 687.83 = $\frac{69500}{4}$ = 17400 LBS. (PG. 2.05)



ASSUME MOMENT ON PLATE IS REACTED BY COUPLE LOADS AS SHOWN IN SKETCH.

COUPLE LOADS = $\frac{1.9 \times 17400}{12.8}$ = 2580 LBS.



SEC. A-A

SEC. A-A STRESS

MOMENT = 3.0 × 2580 + 6050 COS 10° × 2.8
= 7750 + 16,650 = 24200 IN. LBS.

END LOAD = $\frac{17400}{2}$ + 6050 COS 10°
= 8,700 + 5,950 = 14650 LBS.

ALLOW MOMENT = 1.5 × .93 × 72,000 × .425 = 42600 IN. LBS.

$f_c = \frac{14650}{.80}$ = 18,300 PSI

R_B = 24,200 / 42,600 = .57

R_c = 18,300 / .93 × 72,000 = .27

M.S. = $\frac{1}{(.57 + .27)}$ − 1 = .19 M.S.

FORM 1319A

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. SHEET NO. 3.21	
AIRCRAFT: C-105		PREPARED BY	DATE
		McCABE	12-6-55
		CHECKED BY	DATE

UPPER SURFACE PLATES

INNER PLATES - STA. 687.83 - STA. 711.6

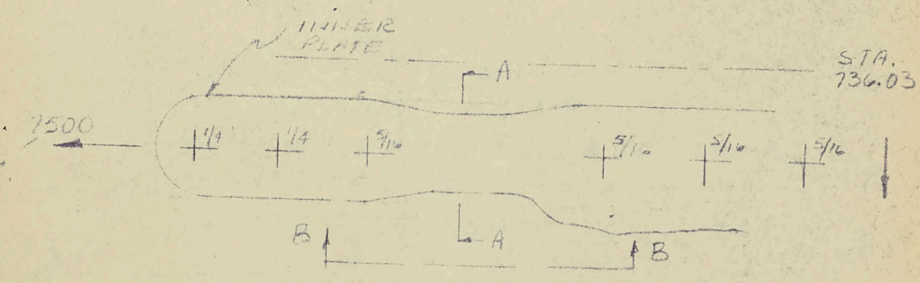
PLATES BETWEEN STA 693.11 & STA 711.60 CARRY LESS LOAD THAN PLATES AFT OF STA. 711.6. SINCE THEY HAVE SAME THICKNESS (.188), THE STRENGTH OF THESE PLATES MAY BE SUBSTANTIATED BY ANALYSIS OF PLATE AFT OF STA. 711.6 (REF. PG. 3.22)

FORM 1319A

UPPER SURFACE SPLICE PLATES

INNER PLATES STA. 711.6 - STA. 742.5

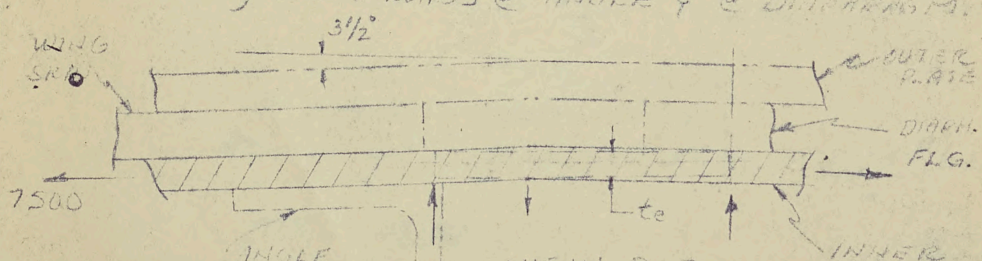
ALL INNER PLATES BETWEEN STA. 711.6 & STA. 742.5 ARE .188 - 75S-T6. THE PLATE AT STA. 736.03 AFT IS THE MOST HIGHLY LOADED IN THIS AREA; CONSEQUENTLY, IT WILL BE ANALYZED HERE, & THE STRENGTH OF THE OTHER PLATES MAY BE SUBSTANTIATED BY COMPARISON.



DIAPHRAGM FLG. LOAD = 60,000 LBS. (PG. 2.05)

LOAD ON SEC. A-A = $\frac{60,000}{8}$ = 7,500 LBS.

DUE TO JOGGLE IN PLATE @ FIN SKIN LINE, AN ECCENTRIC LOAD IS INDUCED IN PLATE. IN SKETCH BELOW ASSUME ECCENTRICITY IS REACTED BY VERT. LOADS @ ANGLE & @ DIAPHRAGM.



VIEW B-B

IF AN EFFECTIVE THICKNESS IS ASSUMED BETWEEN VERT. REACTIONS, THE LOAD PATH BETWEEN REACTIONS MAY BE ASSUMED TO BE IN A STRAIGHT LINE.

FORM 1319A

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No. 3.23	
		PREPARED BY	DATE
		McCABE	12-2-55
		CHECKED BY	DATE

UPPER SURFACE SPLICE PLATES
INNER PLATES STA. 711.6 - STA. 742.5

EFFECTIVE THICKNESS = t_e = .15 IN.
EFF AREA (A-A) = 1.0 x .15 = .150 in^2

$f_t = \frac{7500}{.15}$ = 50,000 PSI

F_t = .93 x 72,000 = 67,000 PSI.

M.S. = $\frac{67000}{50,000} - 1 =$ .34 M.S.

PLATE ATTACHMENT TO WING SKIN
LOAD = 7,500 LBS. (PG. 3.22)
ATTACHMENT IS BY 1-5/16 & 2 1/4" LOCKBOLTS
WING SKIN THICKNESS = .31 IN.
ALLOW. LOAD 1-5/16 BOLT = $\frac{.31}{2}$ x .312 x 137,000

= 6600 LBS.

ALLOW. LOAD 2-1/4" BOLTS = 2 x 4,650 = 9300 LBS.
TOTAL ALLOW. LOAD = 6,600 + 9300 = 15,900 LBS.
M.S = $\frac{15,900}{7,500} - 1 =$ HIGH M.S.

PLATE ATTACHMENT TO DIAPHRAGM
DIAPH. FLG. LOAD = $\frac{60,000}{2}$ = 30,000# (PER SIDE)

ATTACHED BY 3-5/16 BOLTS.
BEARING IN DIAPH. CRITICAL
ALLOW. LOAD = 3 x .31 x .312 x 128,000 = 37,100# (DBL. SHEAR)

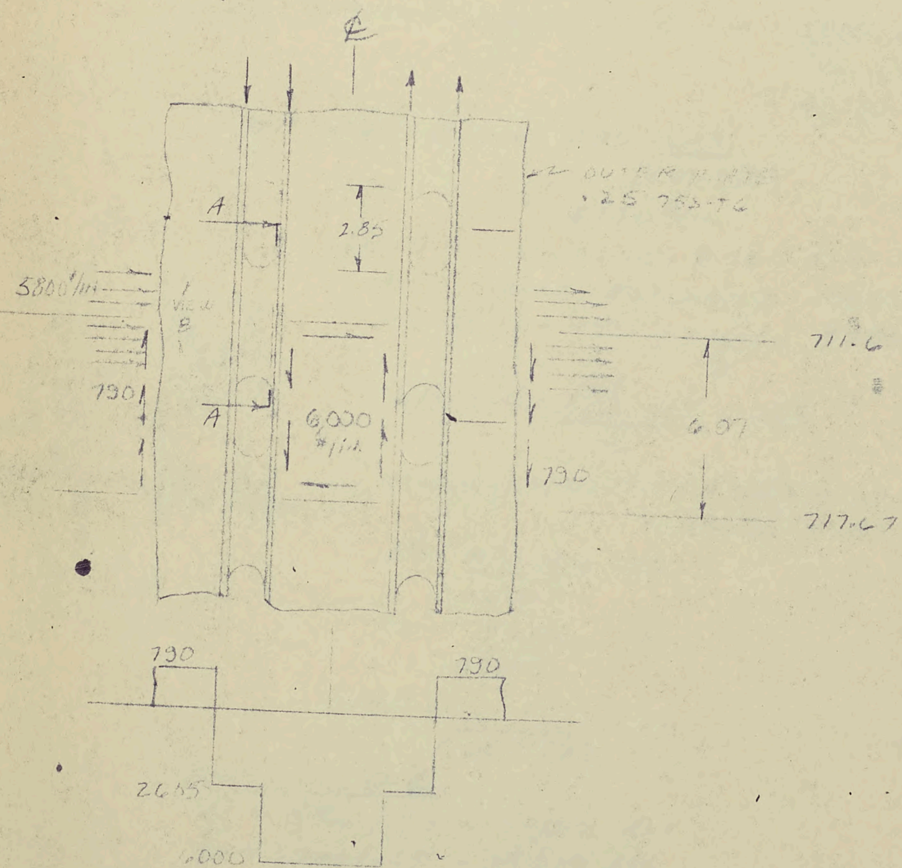
M.S. = $\frac{37,100}{30,000} - 1 =$ .24 M.S.

FORM 1319A

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No. 3.24	
		PREPARED BY	DATE
		McCABE	12-12-55
		CHECKED BY	DATE

UPPER SURFACE PLATES
OUTER PLATE STA. 669 - 742.5
CRITICAL LOADING IS R.R.O CASE @ STA 711.6



INNER WING SKIN STRESS STA 711.6 = 52600 PSI.
SKIN THICKNESS = .22 IN. (REF. 7/0562/6 PG. 2.03)
SKIN END LOAD PER IN. = .22 × 52600 = 11,600 #/IN.
ASSUMING HALF OF LOAD CARRIED BY OUTER PLATE, THEN,
OUTER PLATE END LOAD = 11600/2 = 5800 #/IN.
[illegible] SHEAR = 790 #/IN (REF. 7/0562/6 PG. 1.09)
OUTER PLATE SHEAR @ [illegible] = 6000 #/IN. (REF. 7/0562/6 PG. 1.08)

FORM 1319 A

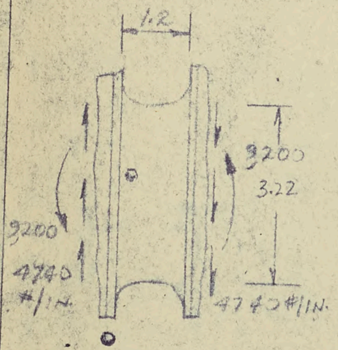
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105		REPORT No.	
		SHEET No. 3.25	
		PREPARED BY McCABE	DATE 1-31-56
		CHECKED BY	DATE

UPPER SURFACE PLATES
OUTER PLATE STA 669 - STA. 742.5
STRESSES @ SEC. A-A

f_c = NET COMPRESSIVE STRESS SEC. A-A $= \frac{5800}{.25} \times \frac{6.07}{(6.07-2.85)}$
$= 43700$ PSI.

NET SHEAR SEC. A-A $= 2605 \times \frac{6.07}{(6.07-2.85)}$
$= 4740$ #/IN.



VIEW B
(PG. 3.24)

BENDING STRESSES @ SEC. A-A
TOTAL SHEAR = 4740 × 3.22 = 15300 #
MOMENT $= 15300 \times \frac{1.2}{2} = 9200$ IN. LBS.

$I/c\,(A\text{-}A) = \frac{\overline{3.22}^2 \times .25}{6} = .43$

ALLOW. MOMENT $= 1.5 \times .43 \times 66,000$
$= 42,600$ IN. LBS.

$R_c = \frac{43,700}{66,000} = .66$

$R_B = \frac{9200}{42,600} = .22$

$M.S. = \frac{1}{(.66 + .19)} - 1 =$ .14 M.S.

STRESSES @ ℄
$f_c = 5,800/.25 = 23,000$ PSI.
$f_s = 6000/.25 = 24,000$ PSI.
$R_c = \frac{23000}{66,000} = .35$

$R_s = \frac{24000}{44,000} = .55$

$R_s^2 + R_c = 1$
M.S. = .34 M.S.

FORM 1319A

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO.	3.26
		PREPARED BY	DATE
		McCABE	9-26-55
		CHECKED BY	DATE

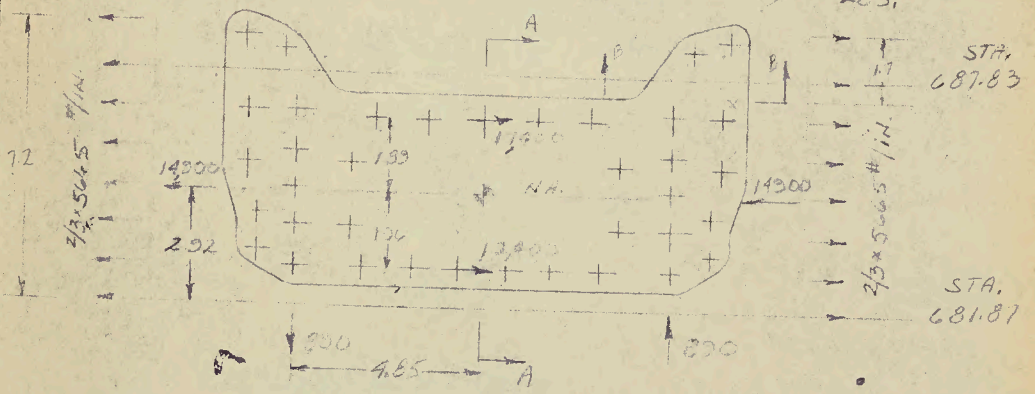
LOWER SURFACE PLATES
INNER PLATE STA 681.87 - STA 657.83

RHO CASE

WING SKIN LOAD PER IN. = 2/3 SYMM. FLIGHT
= 2/3 11,330 #/IN. (PG. 3.04)

LOAD FROM STA 657.83 DIAPH = 69500/4 (PG. 2.65)
= 17,400 LBS

LOAD FROM STA. 681.87 DIAPH = 49,700/4 (PG. 2.95)
12,400 LBS.

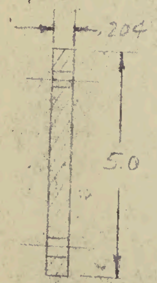


STRESSES AT SEC. A-A

MOMENT (A-A) = $2/3 \times 5665 \left(\frac{7.2}{2} - 2.92\right) + 890 \times 4.85$

$= 2{,}575 + 4{,}320 = 6{,}895$ IN. LBS.

END LOAD = $2/3\ 5665 \times 7.2 = 27{,}200$ LBS.



SEC. A-A
I = 1.6
A = .882

$f_b = \frac{6{,}895 \times 2.5}{1.6} = 10{,}800$ PSI.

$f_c = 27{,}200 / .882 = 30{,}800$ PSI

f_t TOTAL = $30{,}800 + 10{,}800 = 41{,}600$ PSI.

$F_c = 66{,}000$

M.S $= \frac{66{,}000}{41{,}600} - 1 =$ .58 M.S.

FORM 1319A

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

REPORT NO.	
SHEET NO.	3.27
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	9-26-55
CHECKED BY	
DATE	

LOWER SURFACE PLATES
INNER PLATE STA. 681.87 - STA. 687.53

STRESSES AT SEC. A-A
CHECK SYMM. FLIGHT CASE

END LOAD = 5665 x 7.2 = 40,800 LBS.

MOMENT = $5665\left(\frac{7.2}{2} - 2.92\right)$

= 3850 IN. LBS.

$f_b = \frac{3850 \times 2.5}{1.6} = 6,000$ PSI.

$f_t = \frac{40800}{.882} = 46,200$ PSI.

f_t TOTAL = 46,200 + 6,000 = 52,200 PSI.

F_t = 64,000

M.S. = $\frac{64,000}{52,200} - 1$ = .26 M.S.

STRESSES -- SEC. B-B
CRITICAL CASE SYMM. FLIGHT.

MOMENT (B-B) = $\frac{1.7^2}{2} \times 5665$

= 8,200 IN. LBS.

I/c (B-B) = $\frac{2.5^2 \times .204}{6}$ = .285

$f_b = \frac{8200}{.285}$ = 28800 PSI.

NOT CRITICAL

FORM 1319 A

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	5.28
		PREPARED BY	DATE
		McCABE	10-19-55
		CHECKED BY	DATE

LOWER SURFACE PLATES
INNER PLATE STA. 681.83 - STA. 687.83
ATTACHMENT TO WING SKIN

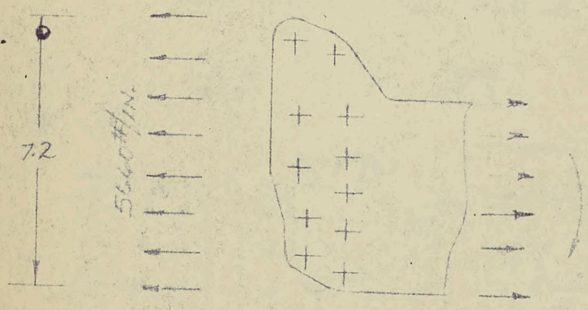


PLATE ATTACHMENT TO WING SKIN IS BY 11-1/4" BOLTS
TOTAL LOAD ON PLATE = 7.2 × 5,660
= 40,800 LBS.

LOAD PER BOLT = $\frac{40,800}{11}$ = 3710 LBS.

BOLTS ALSO CARRY SHEAR LOAD DUE TO FIN BOX BENDING
*FOR SHEAR DUE TO BENDING, USE LOAD PER IN. ON PLATE AT STA. 669. (CONSERVATIVE)

SHEAR LOAD PER IN. = 1,360 #/IN. (PG. 6.22)
LOAD PER BOLT = $\frac{1,360 \times 7.2}{11}$ = 890 LBS.

RESULTANT = $(3710^2 + 890^2)^{1/2}$
= 3,800 LBS.

ALLOW. LOAD = 4,650#

M.S. = $\frac{4650}{3,800}$ - 1 = .22 M.S.

FORM 1319A

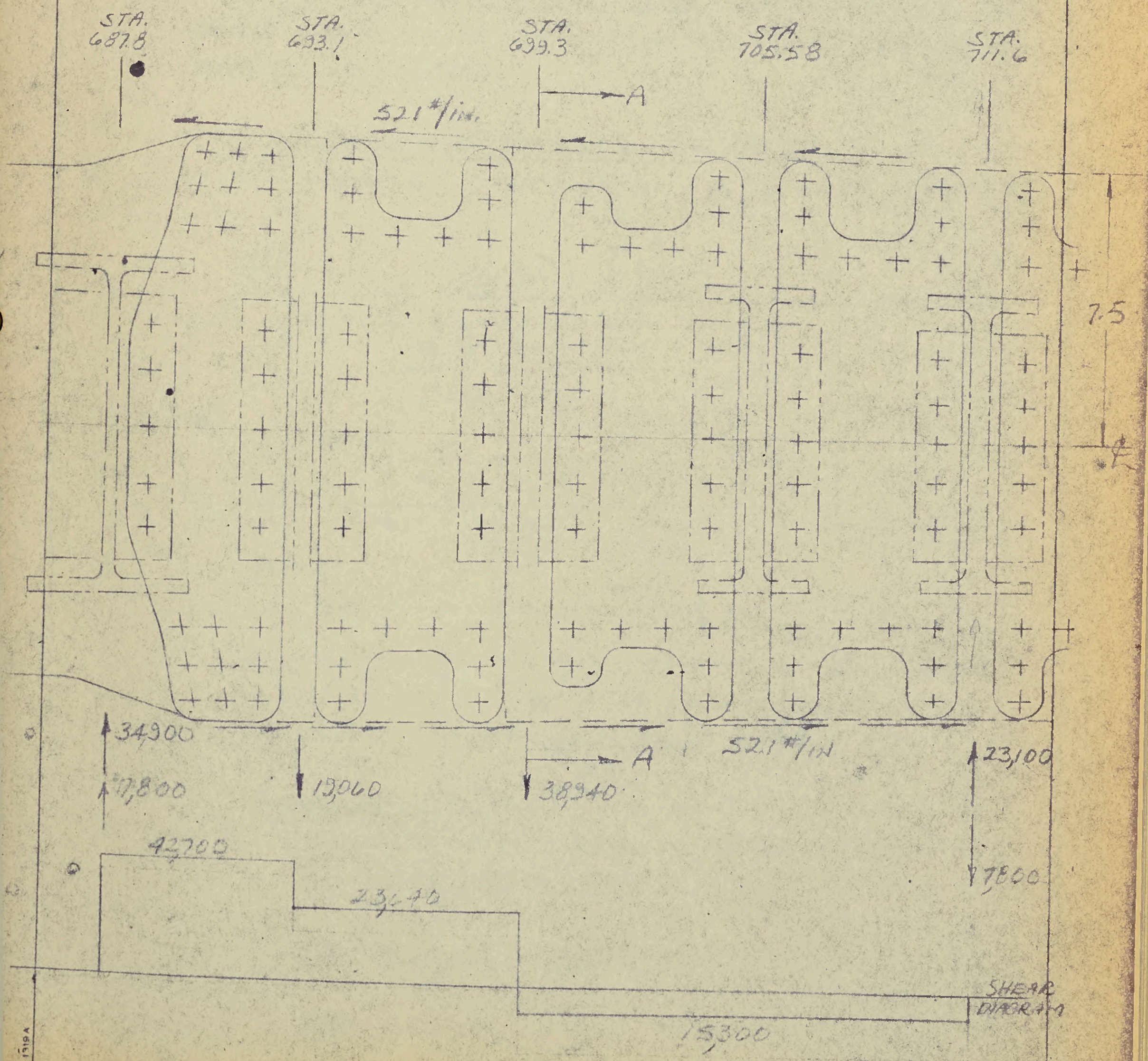
AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.
SHEET NO. 3.29

AIRCRAFT: C-105

PREPARED BY: McCABE — DATE: 7-14-55
CHECKED BY: — DATE:

LOWER SURFACE PLATES
INNER PLATES — STA 687.83 - STA. 711.6
LOADS ON INNER & OUTER PLATES
LOCAL SHEAR FROM JACK LOADS REF. PG.
PRIMARY SHEAR = 521 #/IN. (REF. PG.)
PRIMARY SHEAR LOAD @ STA. 711.6 = 521 x 15 = 7800 #



FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No.	3.3D
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	7-14-55
CHECKED BY	
DATE	

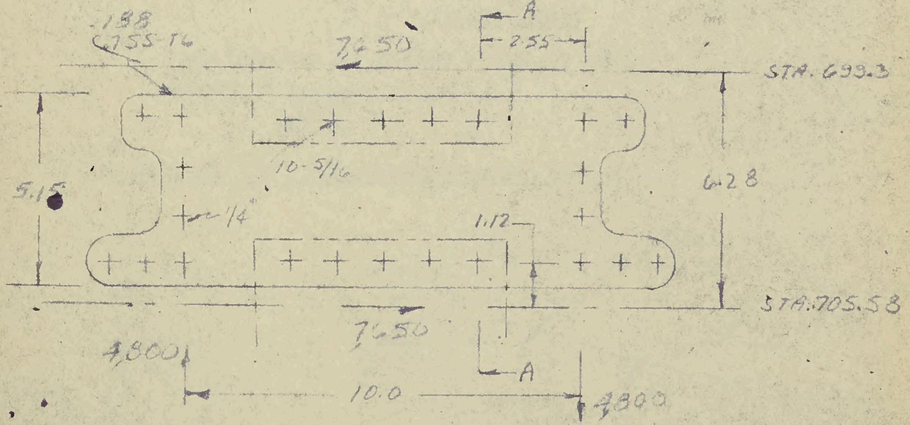
LOWER SURFACE PLATES

INNER PLATES STA. 687.83 – STA 711.6

IF THE LOWER SURFACE FIN BOX STRUCTURE IS TO BE CAPABLE OF BEAMING LOADS BETWEEN STA 687.83 & STA. 711.6, THE SERIES OF PLATES BETWEEN DIAPHRAGMS MUST ACT AS AN INTEGRAL WEB; CONSEQUENTLY, THE PLATE ATTACHMENTS TO DIAPHRAGMS MUST TRANSMIT BEAM SHEAR LOADS.

INNER PLATE STA. 693.3 – STA. 705.58

SHEAR ON PLATE = $\frac{15300}{2}$ = 7650 LBS. (PG. 3.29)



ASSUME MOMENT ON PLATE IS REACTED BY COUPLE LOADS AT ROW OF 1/4" BOLTS SHOWN IN SKETCH.

COUPLE LOADS = $\frac{7650 \times 6.28}{10}$ = 4,800 LBS.

BENDING SEC. A–A

MOMENT = 2.55 x 4,800 = 12,250 IN. LBS.

$I/c = \frac{5.15^2 \times .188}{6} = .83$

$f_b = \frac{12,250}{.83}$ = 14,800 PSI

NOT CRITICAL

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105		REPORT No.	
		SHEET No. 3.31	
		PREPARED BY	DATE
		MCBRBE	7-14-55
		CHECKED BY	DATE

LOWER SURFACE PLATES

INNER PLATE STA 699.3 - STA. 705.58

ATTACHMENT TO DIAPHRAGM

SHEAR ON ATTACHMENTS = 7650 LBS. (PG. 3.30)

MOMENT = 1.12 × 7,650 = 8560 IN. LBS.

$I_P = 14.2$

LOAD ON CRIT. BOLT FROM MOMENT = $\frac{8,560 \times 2.38}{14.2}$

1430 LBS.

LOAD PER BOLT FROM SHEAR = $\frac{7650}{5}$ = 1530 LBS.

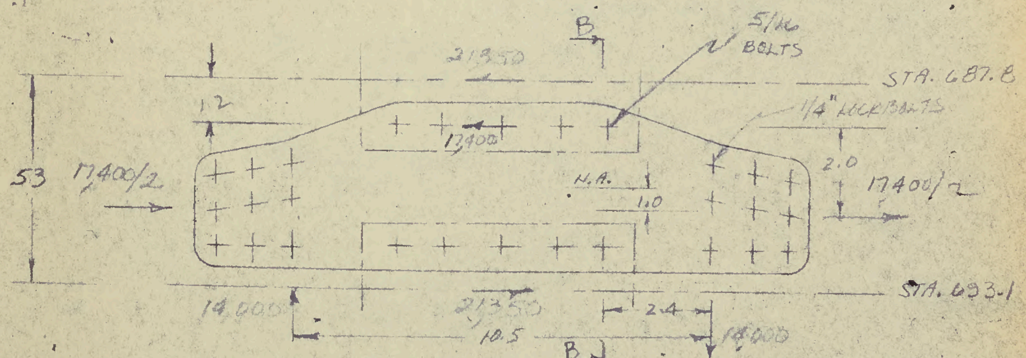
RESULTANT = $\left(\overline{1430}^{2}\ \overline{1530}^{2}\right)^{1/2}$

= 2090 LBS.

ALLOWABLE LOAD = 6,600 LBS

M.S. = $\frac{6600}{2090} - 1$ = HIGH M.S.

INNER PLATE STA. 687.83 - STA. 693.11



SHEAR LOAD ON PLATE = $\frac{42,700}{2}$ = 21,350 LBS. (PG. 3.29)

LOAD FROM STA. 687.8 DIAPH. = $\frac{69,500}{4}$ = 17,400 LBS. (PG. 2.05)

ASSUME MOMENT ON PLATE IS REACTED BY COUPLE LOADS ON INNER ROW OF 1/4" BOLTS AS SHOWN IN SKETCH.

COUPLE LOADS $\frac{21,350 \times 5.3 + 17,400 \times 2.0}{10.5}$

= 14,000 LBS.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO 3.32	
		PREPARED BY	DATE
		McCABE	7-15-55
		CHECKED BY	DATE

LOWER SURFACE PLATES
INNER PLATE STA. 687.83 - STA. 693.11
BENDING SEC B-B (PG. 3.31)

MOMENT = 2.4 × 14000 + 1.0 × 17400/2
= 33,600 + 8,700
= 42,300 IN. LBS.

$I/c = \frac{4.2 \times .204^2}{6} = .60$

$f_b = \frac{42,000}{.60} = 70,000$ PSI.

END LOAD = 17,400/2 = 8,700 LBS.

$f_c = \frac{8700}{.204 \times 4} = 10700$ PSI.

K = 1.5

F_t = 72,000 PSI.

ALLOW. MOMENT = 1.5 × .60 × 72,000
= 64,900 IN. LBS.

$R_B = \frac{42,300}{64,900} = .65$

$R_C = \frac{10700}{72,000} = .15$

$M.S. = \frac{1}{(.65 + .15)} - 1 =$ .25 M.S.

FORM 1319A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No.

SHEET No 3.33

AIRCRAFT: C-105

PREPARED BY McCABE | DATE 7-18-55

CHECKED BY | DATE

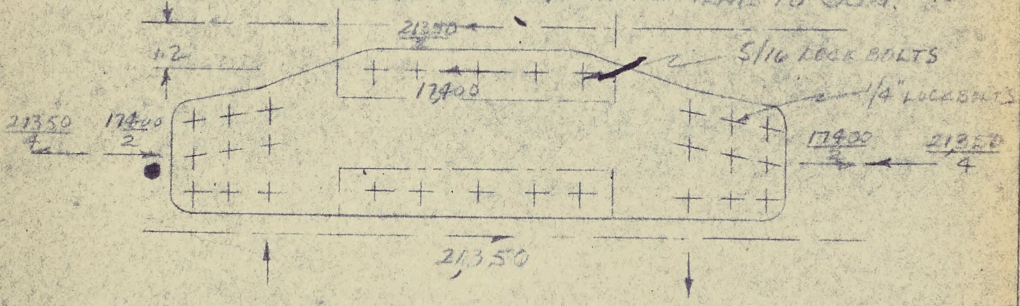
LOWER SURFACE PLATES

INNER PLATE STA 687.83 - STA 693.11

ATTACHMENT TO DIAPHRAGM STA. 687.83

LOADS REF. SKETCH PG. 3.31

IN CHECKING ATTACHMENTS TO STA. 687.83 DIAPHRAGM ASSUME HALF OF 21,350 WEB SHEAR LOAD IS REACTED @ STA. 687.83 & HALF AT 1/4" ATTACHMENTS TO SKIN.



SHEAR LOAD ON ATTACHMENTS = $17{,}400 + \frac{21{,}350}{2}$

= 28,075 LBS.

MOMENT ON ATTACHMENTS = $\frac{21{,}350}{2} \times 1.2$

= 12,800 IN. LBS.

$I_p = 19.5$

LOAD ON CRITICAL BOLT FROM MOMENT

$= \frac{12{,}800 \times 2.8}{19.5} = 1{,}840$ LBS.

LOAD PER BOLT FROM SHEAR = $\frac{28075}{5} = 5{,}620$ LBS.

RESULTANT = $(5600^2 + 1840^2)^{1/2}$

= 5,900

ALLOW. LOAD = 6,600 LBS.

M.S. = $\frac{6600}{5900} - 1 =$ .12 M.S.

FORM 1319A

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO. 3.34	
		PREPARED BY	DATE
		MC CABE	
		CHECKED BY	DATE

LOWER SURFACE PLATES

INNER PLATES – STA. 711.6 – 742.5

THE INNER LOWER PLATES HAVE SAME LOADS AND ARE OF SAME THICKNESS (.183) AS CORRESPONDING UPPER INNER PLATES, THEREFORE, THEY MAY BE SUBSTANTIATED BY COMPARING TO UPPER INNER PLATE ANALYSIS. (PG. 3.22)

OUTER PLATES – STA. 687.83 – 742.5

MAY BE CHECKED BY COMPARING TO CORRESPONDING INNER LOWER PLATES.

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No. 3.35	
		PREPARED BY	DATE
		McCABE	
		CHECKED BY	DATE

SEC. 3 -- ECCENTRIC LOADING DUE TO BEND IN PLATES

DUE TO THE WING SURFACES JOINING THE FIN BOX AT A SLIGHT ANGLE, AN ECCENTRIC LOAD IS INDUCED IN THE FIN BOX PLATES. THE EFFECT OF THIS CONDITION IS CONSIDERED IN THE ANALYSIS THAT FOLLOWS.

ORM 1319A

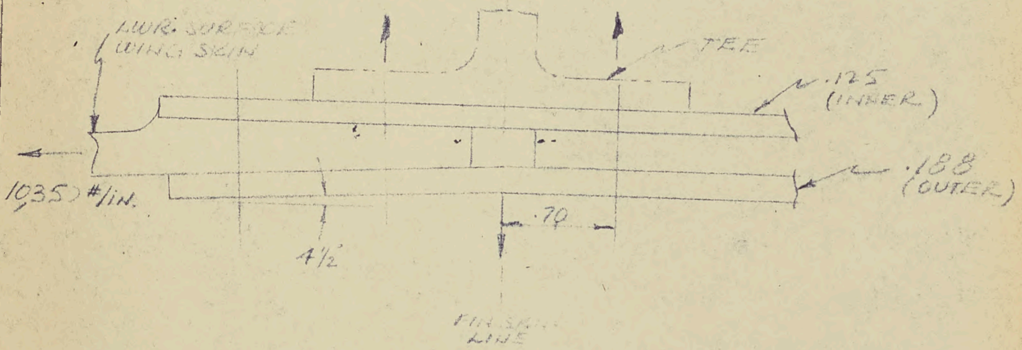
A. V ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No.	3.36
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	
CHECKED BY	
DATE	

ECCENTRIC LOADING ON PLATES — STA. 607.63 — STA. 687.83

THE EFFECT OF THE BEND IN PLATES AT FIN SKIN LINE IN UPPER & LOWER SURFACE PLATES WILL BE CONSIDERED.

LOWER SURFACE STA. 607.63 — STA. 664.7



LOWER SURFACE SKIN LOAD STA. 607 = 10350#/IN. (PG. 3.04)
DUE TO SKIN ANGULARITY (4½°) WITH FIN BOX
A VERTICAL COMPONENT IS PRODUCED WHICH
IS REACTED BY ATTACHMENTS AS SHOWN IN SKETCH

SKIN VERT. COMPONENT $= 10{,}350 \times \sin 4\tfrac{1}{2}^\circ$
$= 806\#$

OUTER PLATE STRESS

MOMENT $= \dfrac{.70 \times 806}{2 \times 2} = 141$ IN. LBS.

$I/c = .188^2 \times 10/6 = .0059$

ALLOW. MOMENT $= 1.5 \times 66000 \times .0059 = 584$

$R_B = 141/584 = .24$

PLATE END LOAD $= 10350/2 = 5170$ #/IN.

$f_t = 5170/.188 = 27{,}500$ PSI.

$F_t = 66{,}000$ PSI.

$R_t = 27{,}500/66{,}000 = .42$

$M.S = \dfrac{1}{(.24 + .42)} - 1 =$ .56 M.S.

FORM 1319A

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**	REPORT No.	
	SHEET No. 3.37	
AIRCRAFT: C-105	PREPARED BY: McCABE	DATE
	CHECKED BY	DATE

ECCENTRIC [illegible] – STA. 607.63 - STA. 687.83

LOWER SURFACE STA 662.7 - STA 687.83

INNER & OUTER PLATES ARE .204" THICK, THEREFORE, STRUCTURE MAY BE SUBSTANTIATED BY COMPARING TO ANALYSIS OF LWR. PLATES FWD. OF STA. 662.7

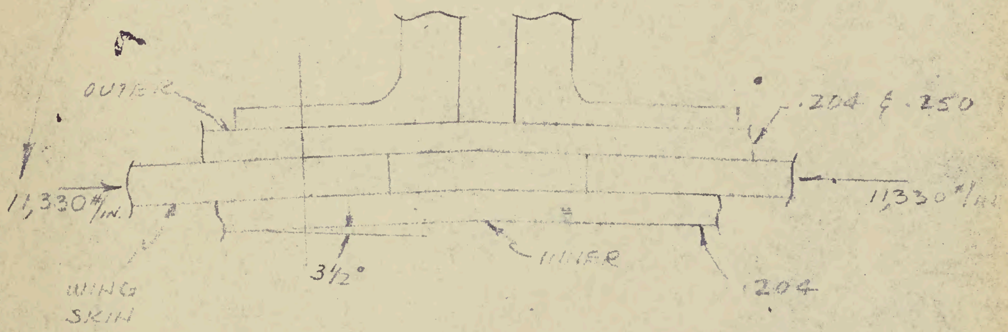
RM 1319 A

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

REPORT NO.	
SHEET NO.	338

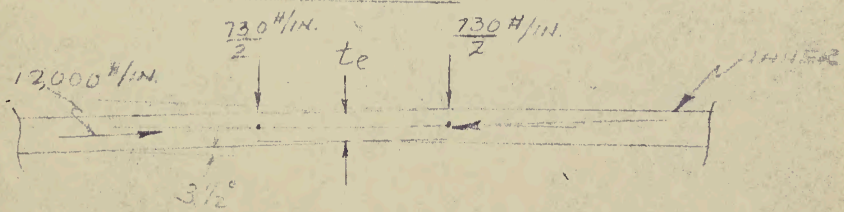
AIRCRAFT:		PREPARED BY	DATE
C-105	/	McCABE	9-6-55
		CHECKED BY	DATE

WING SKIN-FIN BOX JOINT ECCENTRICITY
UPPER SURFACE STA. 607.63 - STA. [illegible]



MAX. WING SKIN END LOAD = 11330 #/IN. (FIG. 3.04)
NET LOAD PER IN. IN SINGLE SPLICE PLATE BETWEEN SLOTS IN PLATE $= \frac{5.7}{2.7} \times \frac{11330}{2} = 12{,}000$ #/IN.
VERT. COMPONENT DUE TO ANGULARITY OF PLATE AT FIN BOX = 12000 SIN 3½°
= 730 #/IN.

STRESS IN INNER PLATE



ASSUME COMPONENT IS REACTED AS SHOWN IN SKETCH, THEN BY USING AN EFFECTIVE THICKNESS ACROSS JOGGLE IN PLATE, LOAD PATH CAN BE ASSUMED TO BE IN A STRAIGHT LINE.

FORM 1319A

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No. 3.39	
		PREPARED BY	DATE
		McCABE	9-6-55
		CHECKED BY	DATE

WING SKIN-[illegible]BOX JOINT ECCENTRICITY
UPPER SURFACE STA. 667.63 : STA 687.83

EFFECTIVE THICKNESS OF PLATE AT JOGGLE
= te = .185 IN.

$$fc = \frac{12,000}{.185} = 65,000 \text{ PSI.}$$

Ft = 66,000 PSI

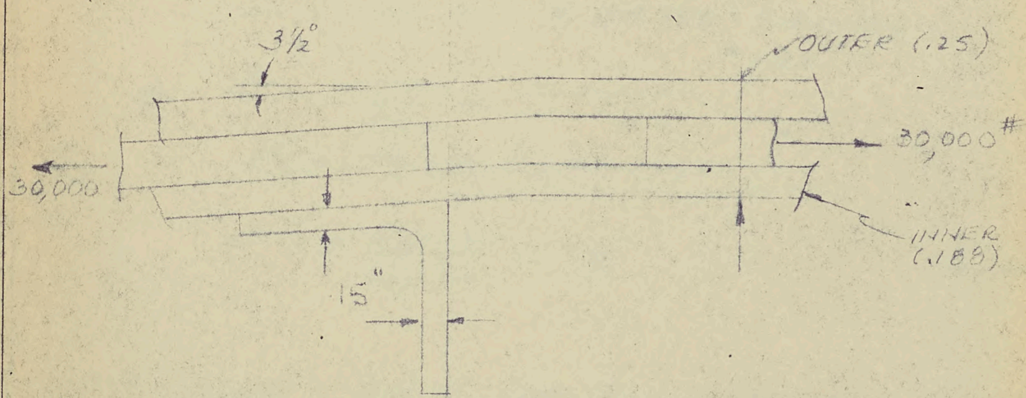
$$M.S. = \frac{66,000}{65,000} - 1 \qquad .01 \text{ M.S.}$$

FORM 1319A

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

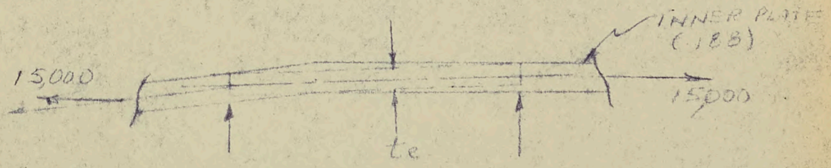
REPORT No.	
SHEET No.	3.40
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	9-7-55
CHECKED BY	
DATE	

WING SKIN-FIN BOX JOINT ECCENTRICITY
UPPER SURFACE STA. 7116 - STA 742.5



ASSUME LOAD FROM DIAPHRAGM ONLY IS CARRIED BY INNER PLATE, THEN,
MAX. DIAPH. LOAD PER SIDE (STA 736.03) = 60,000/2 (PG. 2.05)
= 30,000#

LOWER PLATE LOAD STA. 736.03 = 30,000/2 = 15,000#
VERT. COMPONENT = 15000 SIN 3½° = 920#



ASSUME VERTICAL COMPONENT IN PLATE IS REACTED AS SHOWN IN SKETCH, THEN, BY USING AN EFFECTIVE THICKNESS ACROSS JOGGLE, LOAD PATH CAN BE ASSUMED TO BE IN A STRAIGHT LINE.

FORM 1319A

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO.	3.41
		PREPARED BY	DATE
		MCCABE	9-8-55
		CHECKED BY	DATE

WING SKIN FINAL JOINT ECCENTRICITY
UPPER SURFACE STA. 711.6 — STA. 742.5

EFFECTIVE THICKNESS OF PLATE = t_e = .150 IN.
AREA LWR. PLATE @ STA. 736 = 2.0 x .150
= .30

$$f_t = \frac{15,000}{.30} = 50,000 \text{ PSI.}$$

$$F_t = .93 \times 72,000 = 67,000$$

$$M.S. = \frac{67,000}{50,000} - 1 = \quad .34 \text{ M.S.}$$

LOWER SURFACE STA. 711.6 — STA. 742.5
NET AREA OF LOWER PLATES IS GREATER THAN UPPER SURFACE PLATES BECAUSE THEY DO NOT CONTAIN SLOTS; THEREFORE, STRUCTURE CAN BE SUBSTANTIATED BY COMPARING TO UPPER SURFACE (STA. 711.6 TO STA. 742.5)

RM 1319 A

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

REPORT NO.
SHEET NO. 4.01

AIRCRAFT: C-105

PREPARED BY	DATE

CHECKED BY	DATE

PART IV – FIN BOX LONGITUDINAL ANGLES & TEES.

FORM 1319A

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

REPORT NO.		
SHEET NO.	A.02	
AIRCRAFT: C-105	PREPARED BY	DATE
	McCABE	
	CHECKED BY	DATE

LONGITUDINAL ANGLES & TEES
DESCRIPTION

THE FIN BOX LONGITUDINAL ANGLES & TEES RUN IN A FORE & AFT DIRECTION & ATTACH TO THE FIN BOX STRUCTURE AT THE INTERSECTION OF THE VERT. & HORIZ. PLATES. THEY PERFORM THE FOLLOWING FUNCTIONS.

1) ALL ANGLES & TEES BETWEEN STA. 637 & STA. 742.5 SERVE TO RESIST THE VERT. COMPONENT OF WING SKIN END LOAD INDUCED BY BEND IN FIN BOX HORIZ. PLATES.

2) OUTER ANGLES ON THE UPPER SURFACE PLATES AT INTERSECTION OF FIN SKIN ACT TO TRANSMIT FIN TORSIONAL SHEAR FROM THE FIN SKIN TO THE FIN BOX UPPER PLATES.

3) ANGLES & TEES BETWEEN STA. 624 & STA. 681, IN ADDITION TO (1) ABOVE, CARRY LOADS INDUCED BY FIN BOX BENDING.

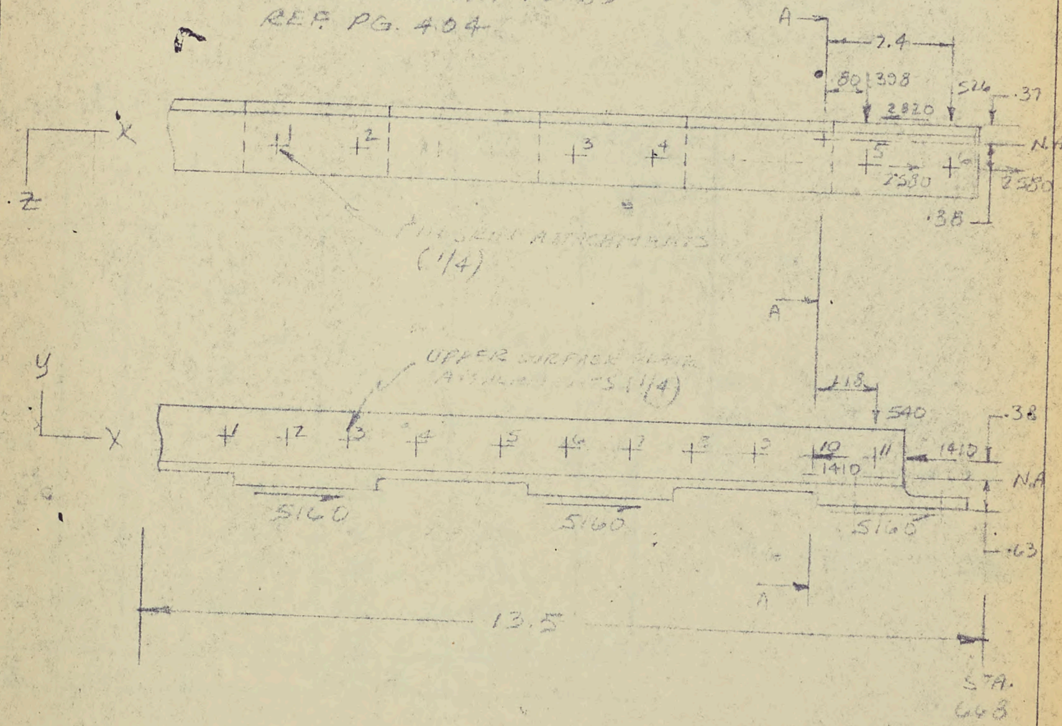
FORM 1319A

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

AIRCRAFT: C-105		REPORT NO.
		SHEET NO. 403
PREPARED BY	DATE	
McCABE		
CHECKED BY	DATE	

FIN BOX LONGITUDINAL ANGLES & TEES
STA 627 - STA. 669 — UPPER SURFACE - OUTER ANGLE

FOR ATTACHMENT LOADS
REF. PG. 404



$$My\,(A\text{-}A) = 2\times 2{,}580\times .38 + 2{,}820\times .37 - 2.4\times 526 - .80\times 398$$
$$= 1{,}960 + 1{,}040 - 1{,}260 - 320$$
$$= \underline{1420\ \text{IN. LBS.}}$$

$$Mz\,(A\text{-}A) = 5{,}160\times .63 + 2\times 1{,}410\times .38 - 1.18\times 540$$
$$= 3{,}260 + 1{,}070 - 640$$
$$= \underline{3690\ \text{IN. LBS.}}$$

END LOAD = 5160 - 2×1410
5160 - 2,820 = <u>2340# (TENS.)</u>

FORM 1319A

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

REPORT No.	
SHEET No.	404
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	
CHECKED BY	
DATE	

FIN BOX LONGITUDINAL ANGLES & TEES
STA. 607 – STA. 669 – UPPER SURFACE – OUTER ANGLE
ATTACHMENT TO FIN BOX HORIZ. PLATES

SHEAR PER ANGLE = 2300 × 13.5/2 = 15500#
MOMENT = 1.0 × 15,500 = 15,500 IN. LBS.
$M/I = 15500/176.4 = 88$
(REF. SKETCH PG. 403)

	A	X	$A \cdot X^2$	LOAD FROM MOMENT $\frac{M}{I} \cdot x \cdot A$	LOAD FROM SHEAR $\frac{15500}{11}$
1	1.0	-6.33	40.	556	1410
2	↓	-5.13	26.4	451	↓
3		-3.94	15.6	347	
4		-2.65	7.0	234	
5		-1.04	1.1	92	
6		.21		19	
7		1.42	2.0	125	
8		2.61	6.8	230	
9		3.81	14.6	335	
10		4.98	25.	440	
11	1.0	6.16	37.9	540	1410
Σ	11.0		176.4		

MAX BOLT LOAD = $(1410^2 + 556^2)^{1/2} = 1,516$#
ALLOW. LOAD = 4,650#
M.S. = $\frac{4650}{1510}$ = HIGH M.S.

ATTACHMENT TO FIN SKIN
MOMENT = .70 × 15,500 = 10,900 IN. LBS.
$\frac{M}{I} = \frac{10,900}{134.3} = 81$
REF. SKETCH. PG.

	A	X	AX^2	LOAD FROM MOMENT $\frac{M}{I} \cdot x \cdot A$	LOAD FROM SHEAR $\frac{15500}{6}$
1	1.0	6.50	42.3	526	2580
2	↓	4.95	24.5	400	↓
3		.83	.7	67	
4		.72	.5	58	
5		4.90	24.0	398	
6	1.0	6.50	42.3	526	2580
Σ			134.3		

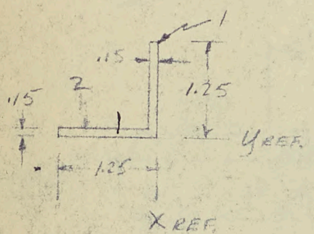
MAX. BOLT LOAD = $(526^2 + 2580^2)^{1/2} = 2640$#
ALLOW. LOAD = 4,650#
M.S. = $\frac{4650}{2640} - 1$ = .76 M.S.

FORM 1319A

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

AIRCRAFT: C-105		REPORT NO.:	
		SHEET No. 405	
		PREPARED BY	DATE
		McCABE	
		CHECKED BY	DATE

FIN BOX LONGITUDINAL ANGLES & TEES
STA. 607 – STA. 669 – UPPER SURFACE – OUTER ANGLE
SEC. A-A (PG 403)
SECTION PROPERTIES



SEC. A-A
(PG. 403)

	A	Z	AZ	AZ²	I₀
1	.187	.625	.1170	.073	.025
2	.165	.075	.0124	.0009	
Σ	.352	$\bar{z}$ = .37	.1234	.0739	.025

$I_y = I_x = .0739 + .025 - .37 \times .1234$
$= .0989 - .048 = .051$

STRESSES

$f_{bz} = \dfrac{3,690 \times .88}{.051} = 63,600$ PSI. (COMPRESSION)

$f_{by} = \dfrac{1,420 \times .37}{.051} = 10,300$ PSI. (COMPRESSION)

$f_t = \dfrac{2,340}{.352} = 6,650$ PSI. (TENS.)

$f_{(TOTAL)} = 63,600 + 10,300 - 6,650$
$= 67,250$ PSI.

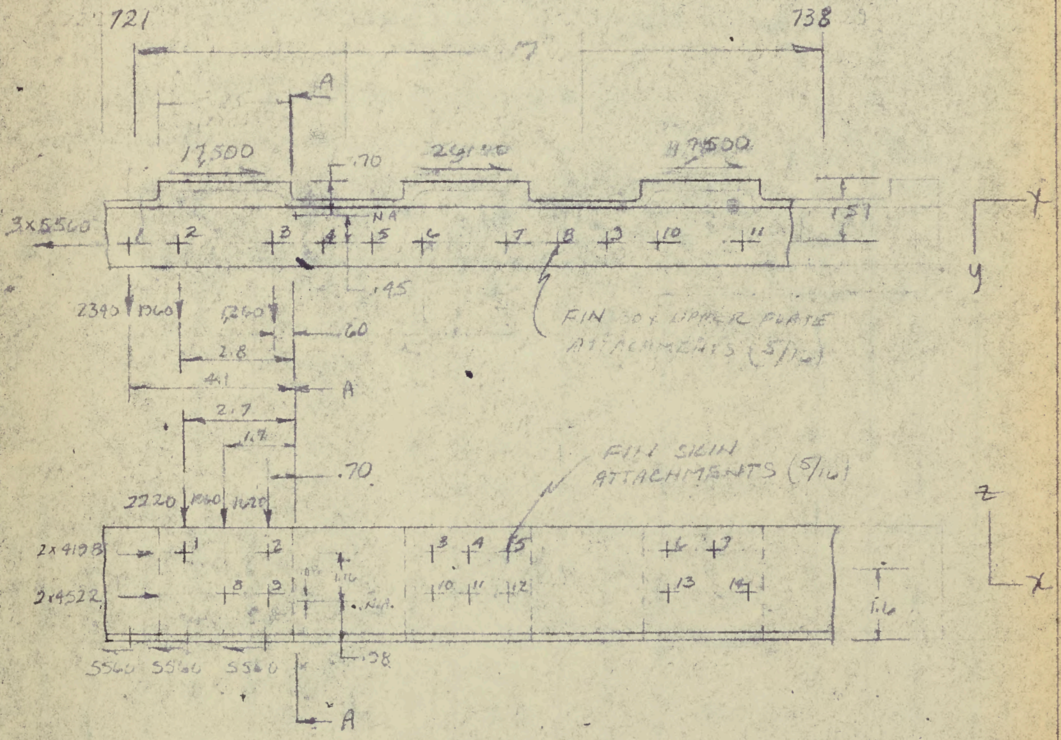
$F_c = 78,000$ PSI.

$M.S. = \dfrac{78,000}{67,250} - 1 =$ .16 M.S.

FIN BOX LONGITUDINAL ANGLES & TEES

STA. 669 – STA. 742.5 – UPPER SURFACE – OUTER ANGLE

(FOR ATTACHMENT LOADS REF PGS 4.07 & 4.08)



M_y (A-A) = 3x5560x.08 + 2x4522x.08 + 2x4198x1.16 − 2.7x2220 − 1.7x1960 − .70x1620
= 16,700 + 720 + 9,740 − 6,000 − 3,320 − 1,130
= 16,710 IN.LBS.

M_z (A-A) = 17,500x.70 + 3x5560x.45 − 4.1x2340 − 2.8x1960 − .60x1260
= 12,250 + 7500 − 9700 − 5500 − 750
= 3,800 IN.LBS

END LOAD = 17,500 − 3x5560
= 17,500 − 16,700 = 800# (COMPRESSION)

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

REPORT NO.	
SHEET NO.	4.07
PREPARED BY	DATE
McCABE	
CHECKED BY	DATE

AIRCRAFT: C-105

FIN BOX LONGITUDINAL ANGLES & TEES.
STA. 663 – STA. 742 – UPPER SURFACE – OUTER ANGLE ATTACHMENT TO FIN SKIN

MOMENT = 1.6 × 61,100 = 97,800 IN. LBS.

M/I = 97800 / 307.8 = 318
(REF. SHEET 4.06)

	A	Z	X	$A \cdot Z^2$	AX^2	LBS FROM MOMENT HORIZ. $\frac{M}{I} z \cdot A$	LBS FROM MOMENT VERT. $-\frac{M}{I} x \cdot A$	LOAD FROM SHEAR HORIZ. = $\frac{61100}{14}$	TOTAL HORIZ.
1	1.0	.51	-7.0	.26	49.0	162	2220	4360	4108
2			-5.09		26.0		1620		
3			-1.03		1.1		330		
4			-.02		—		—		
5			1.0		1.0		320		
6			5.07		26.8		1616		
7			7.32		53.8	162	2320		4108
8			-6.17		38.8	-162	1960		4522
9			-5.03		26.0		1620		
10			-1.03		1.1		330		
11			-.02		—		—		
12			1.0		1.0		320		
13			5.07		25.8		1610		
14	1.0	.51	7.32	.26	53.8	-162	2320	4360	4522
Σ	14.0			3.64	304.2				

$I_p = 304.2 + 3.6 = 307.8$

MAX. BOLT LOAD = $(2320^2 + 4522^2)^{1/2} = 5050^*$
ALLOW. LOAD = 7,300

$M.S. = \frac{7,300}{5,050} - 1 =$ .44 M.S.

FORM 1319A

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

REPORT NO.
SHEET NO. 4.08

AIRCRAFT: C-105

PREPARED BY: McCABE | DATE:
CHECKED BY: | DATE:

FIN BOX LONGITUDINAL ANGLES & TEES

STA. 665 - STA. 742.5 - UPPER SURFACE - OUTER ANGLE ATTACHMENT TO FIN BOX HORIZ. PLATES

SHEAR PER ANGLE = 7200 × 17/2 = 61,100# (FIG. 1.??)

MOMENT = 1.30 × 61,100 = 79500 IN. LBS.

M/I = 79500 / 264.4 = 300

	A	X	$A \cdot X^2$	LOAD FROM MOMENT $\frac{M}{I} \times A$	LOAD FROM SHEAR $\frac{61,100}{11}$
1	1.0	-7.8	61.0	2340	5560
2	↓	-6.55	43.0	1960	↓
3		-4.19	17.6	1260	
4		-2.93	8.6	880	
5		-1.67	2.8	500	
6		-.42	.2	126	
7		1.93	3.7	580	
8		3.19	10.2	956	
9		[illegible]	19.8	1330	
10	↓	5.70	32.5	1710	↓
11	1.0	8.06	65.0	2420	5560
Σ	11.0		264.4		

MAX. BOLT LOAD = $\left(\overline{5560}^2 + \overline{2420}^2\right)^{1/2}$ = 6040#

ALLOW. LOAD = 7300 LBS.

M.S. = $\frac{7300}{6040} - 1$ = .20 M.S.

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

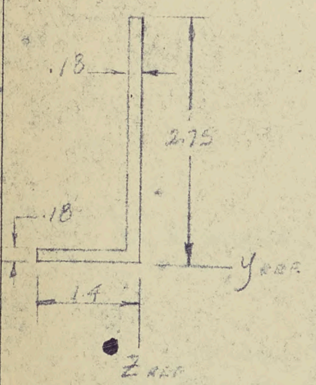
REPORT NO.
SHEET NO. 4.09

AIRCRAFT: C-105

PREPARED BY	DATE
McCABE	
CHECKED BY	DATE

FINBOX LONGITUDINAL ANGLES & TEES
STA. 663 - STA. 742.5 UPPER SURFACE ~ OUTER ANGLE
SEC. A-A

SECTION PROPERTIES



SECTION A-A
(PG. 4.04)

	A	Z	AZ	AZ²	I_0
1	.495	1.375	.680	.935	.310
2	.219	.09	.020	.002	
Σ	.714	$\bar{z}$ = .98	.700	.937	.310

$I_y = .310 + .937 - .70 \times .98$
$1.247 - .685 = .562$

	A	y	Ay	Ay²	I_0
1	.495	.09	.0445	.004	
2	.219	.79	.1730	.137	.027
Σ	.714	$\bar{z}$ = .305	.2175	.141	.027

$I_z = .141 + .027 - .305 \times .2175$
$.168 - .066 = .102$

STRESSES

$f_{by} = \frac{16710 \times .98}{.562} = 29,200$ PSI. (TENS.)

$f_{bz} = \frac{3800 \times 1.095}{.102} = 40,600$ PSI. (TENS.)

$f_c = \frac{800}{.714} = 1,120$ PSI. (COMPRESSION)

$f_{TOTAL} = 40,600 + 29,200 - 1,120$
$= 68,680$ PSI.

$F_t = 78,000$

$M.S. = \frac{78,000}{68680} - 1 =$ .13 M.S.

FORM 1319A

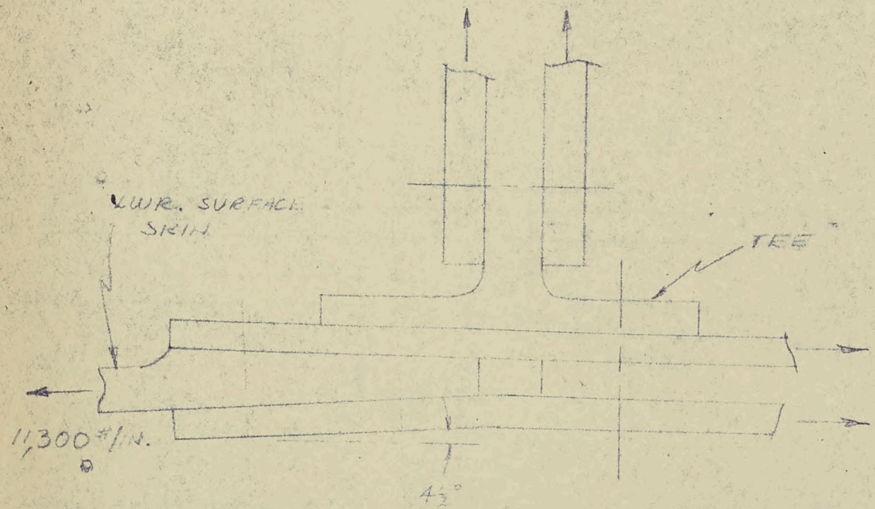
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No.
SHEET No. 4.10

AIRCRAFT: C-105

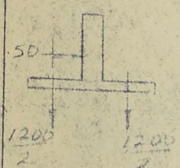
PREPARED BY: McCABE | DATE:
CHECKED BY: | DATE:

FIN BOX LONGITUDINAL ANGLES & TEES
STA. 607 – STA. 681 – LOWER SURFACE TEE



LWR. SURFACE SKIN LOAD = 11,330 #/IN. (PG. 3.04)
SKIN VERT COMPONENT = 11,330 × $\sin 4\frac{1}{2}°$
= 885 #/IN.

FLANGE BENDING OF TEE
DIAPH. SPACING = 11.4"
TEE LENGTH = 8.4
LOAD ON TEE = $\frac{11.4}{8.4}$ × 885 = 1200 #/IN.



MOMENT = .50 × 1200/2 = 300 IN. LBS.
I/c = .15 × 1.0/6 = .00375
ALLOW. MOMENT = 1.5 × .00375 × 66,000
371 IN#

M.S. = $\frac{371}{300}$ − 1 = .24 M.S.

FOR TEE ATTACH TO FIN BOX REF. PG. 6.24, 6.25

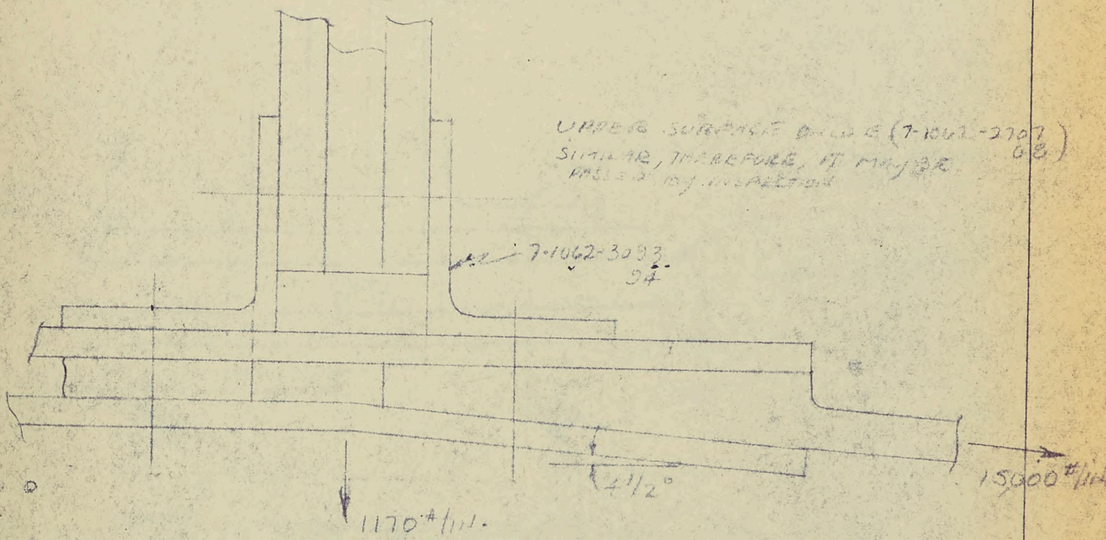
FORM 1319A

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

AIRCRAFT: C-105		REPORT No.	
		SHEET No. 4.11	
		PREPARED BY	DATE
		McCABE	
		CHECKED BY	DATE

FIN BOX LONGITUDINAL ANGLES & TEES

STA. 687.83 – LOWER SURFACE ANGLES

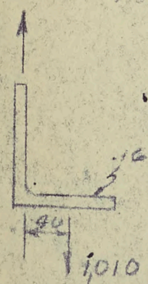


UPPER SURFACE ANGLE (7-1062-2707/08) SIMILAR, THEREFORE, IT MAY BE PASSED BY INSPECTION

MAX. LWR. SURFACE SKIN LOAD STA 687 = 15,000 #/IN. (PG. 3.04)
SKIN LOAD VERT. COMPONENT = 15,000 SIN 4½°
= 1,170 #/IN.

FLANGE BENDING OF ANGLES

BOLT SPACING = 5.2
LENGTH OF ANGLE = 3.0 IN.
LOAD PER IN. ON ANGLE = $\frac{5.2}{3.0} \times \frac{1170}{2}$ = 1,010 #/IN.



MOMENT = .40 × 1010 = 404 IN. LBS.

$I/c = \frac{.16^2 \times 1.0}{6} = .00426$

f_b = 404 / .00426 = 95,000 PSI.

ALLOW. MOMENT = 1.5 × .00426 × 66,000
= 422 IN. LBS.

M.S. = $\frac{422}{404} - 1$ = .05 M.S.

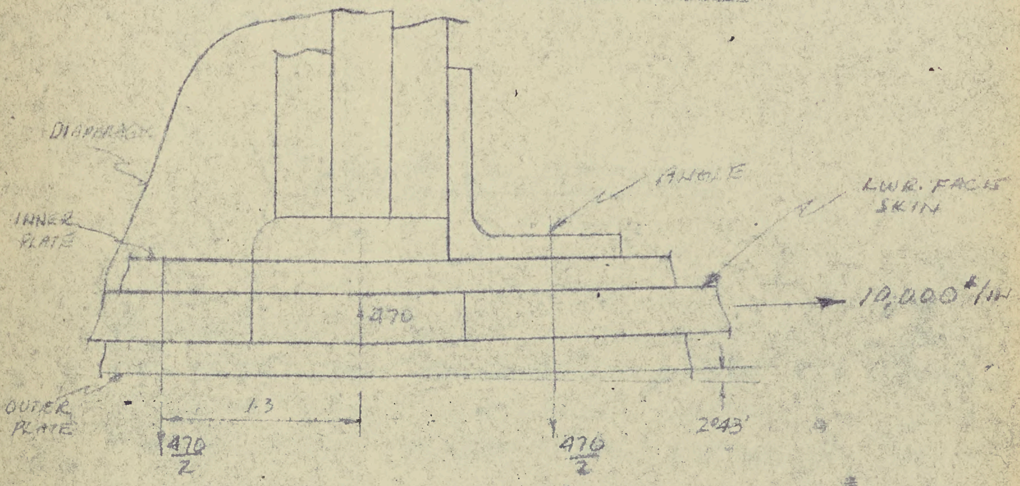
FORM 1319A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No.	
SHEET No.	4.12
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	7-21-55
CHECKED BY	
DATE	

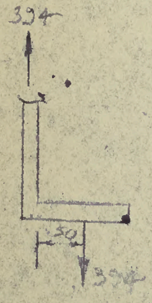
FIN BOX LONGITUDINAL ANGLES & TEES
STA 711.6 - STA 742.5 LWR SURFACE



MAX. DIAPHRAGM LOAD = 60,000# (PG. 2.05)
DIAPH. SPACING 6" APPROX.
SKIN END LOAD/IN. = $\frac{60000}{6}$ = 10,000#/IN.

DUE TO ANGULARITY BETWEEN FIN BOX LWR. SURFACE CONTOUR & WING SKIN CONTOUR, A VERTICAL COMPONENT IS PRODUCED AT INTERSECTION OF THE TWO SURFACES,

VERT. COMPONENT = 10,000 SIN 2°43'
= 470#/IN.



AS AN INITIAL CHECK, ASSUME TOTAL LOAD IS REACTED BY ANGLE, THEN,
MOMENT ON ANGLE FLANGE = .50 x 470 = 235 IN.LBS
$(I/c) = \overline{.15}^2 \times 1.0 / 6 = .0037$

ALLOW. MOMENT = 66000 x 1.5 x .0037 = 366 IN.LBS.
M.S. = $\frac{366}{235} - 1 =$ .55 M.S.

FORM 1319 A

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

AIRCRAFT: C-105		REPORT NO.	
		SHEET NO. 5.01	
		PREPARED BY	DATE
		McCABE	
		CHECKED BY	DATE

PART V - FITTINGS

FORM 1319 A

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO. 5.02	
		PREPARED BY	DATE
		McCABE	
		CHECKED BY	DATE

FITTINGS
DESCRIPTION

THE FITTINGS DESCRIBED BELOW ARE SUBSTANTIATED BY THE ANALYSIS THAT FOLLOWS.

FUS. VERT. STRUT PICKUP – STA. 663.47

THE VERT. STRUT FITTING IS ATTACHED TO THE FIN BOX LWR. SURFACE BETWEEN DIAPHRAGMS @ STA. 657.94 & STA. 663.70. IT REACTS VERT. LOAD FROM THE FUS. STRUT @ STA 663.47.

FUS. VERT. STRUT PICKUP – STA. 714.85

THE VERT. STRUT FITTING IS ATTACHED TO THE FIN BOX LWR. SURFACE BETWEEN DIAPHRAGMS @ STA. 711.6 & STA. 717.67. IT REACTS VERT. LOAD FROM THE FUS. STRUT @ STA. 714.85.

FIN REAR SPAR ATTACHMENT FITTING – STA. 736.03

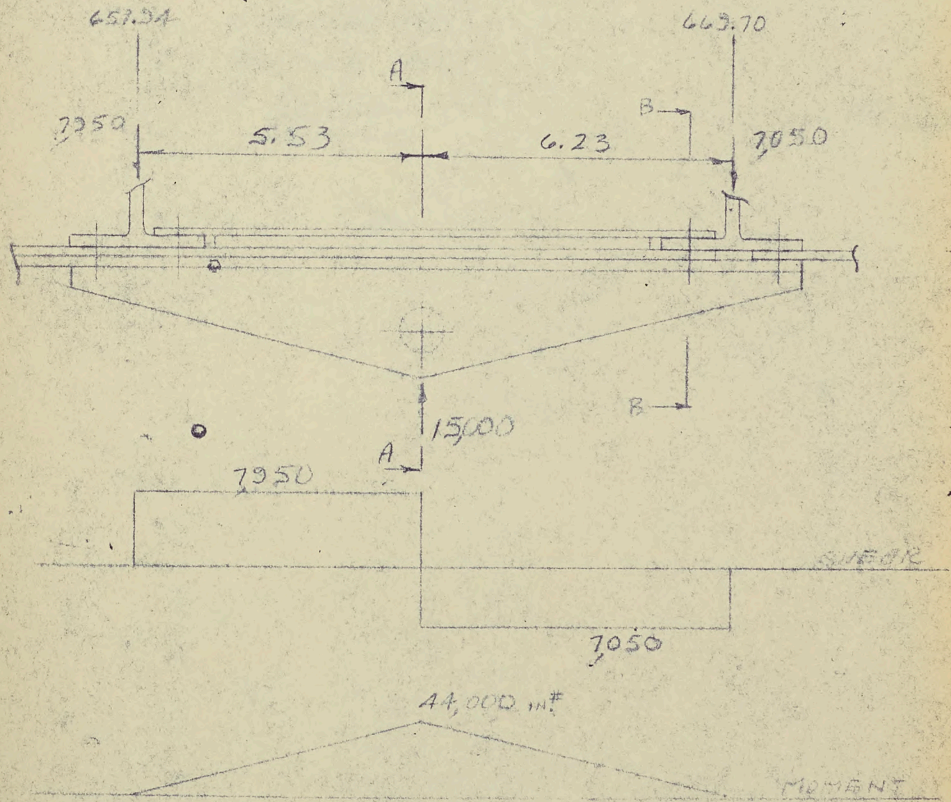
THE R/S ATTACHMENT FITTING SERVES TO TRANSMITT SHEAR FROM THE FIN R/S TO THE FIN BOX UPPER SURFACE STRUCTURE.

FOR ANALYSIS OF FIN SHEAR FITTINGS AT STAS. 646.62, 671.43, 696.23 & 726.03 REFER TO . FOR ANALYSIS OF CENTER ENGINE THRUST MOUNT FITTING STA. 624, REFER TO 7/0562/25.

FORM 1319A

FUS. VERT. STRUT PICKUP STA. 663.47

TENSION LOAD = 10,000 LBS. PER W...
COMPRESSION LOAD = 15,000 LBS.



SEC. A-A STRESSES

TENSION LOAD CRITICAL

$$\text{MOMENT} = \frac{10,000}{15,000} \times 44,000 = 29,400 \text{ IN. LBS.}$$

STRESS ON LUG IS CRITICAL

$$I/c = 2.06/2.8 = .73 \quad (\text{PG. } 5.05)$$

$$f_b = \frac{29400}{.73} = 40,300 \text{ PSI.}$$

$$\text{HOOP TENSION STRESS IN LUG} = \frac{10,000}{2 \times .180} = 27,800 \text{ PSI.}$$

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

AIRCRAFT: C-105		REPORT No.	SHEET No. 5.04
		PREPARED BY McCABE	DATE 6-19-56
		CHECKED BY	DATE

FUS. VERT. STRUT PICK-UP ~ STA. 663.47
SEC. A-A STRESSES

$$f_{TOTAL} = 40{,}300 + 27{,}800 = 68{,}100 \text{ PSI.}$$

$$F_t = 80{,}000 \text{ PSI.}$$

$$M.S. \doteq \frac{80{,}000}{68{,}100 \times 1.15} - 1 = .02 \text{ M.S.}$$

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

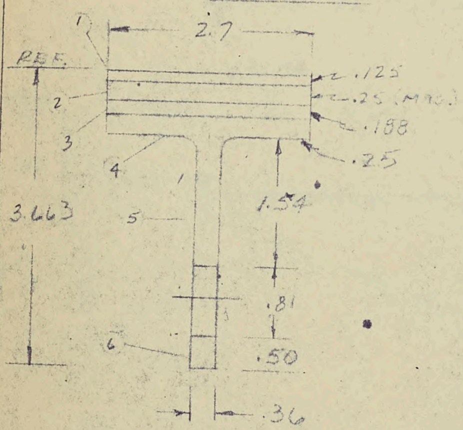
REPORT No.
SHEET No. 5.05

AIRCRAFT: C-105

PREPARED BY: McCABE | DATE: 12-5-55
CHECKED BY: | DATE:

FUS. VERT. STRUT PICKUP STA. 663.47
SECTION PROPERTIES

SEC. A-A (PG. 5.03)



	AREA	$\bar{z}$	AZ	AZ²	I_o
1	.338	.062	.021	.001	
2	.438	.250	.109	.027	
3	.518	.469	.243	.114	
4	.675	.688	.464	.318	
5	.555	1.583	.879	1.390	.110
6	.180	3.413	.615	2.100	
Σ	2.704	$\bar{z}$ = .86	2.331	3.950	.110

$I = 3.950 + .110 - .86 \times 2.331$
$= 4.060 - 2.0$
$= 2.06$

SEC. B-B (PG. 5.03)

	A	Z	AZ	AZ²	I_o
1	.338		.021	.001	
2					
3	.518		.243	.114	
4	.675		.464	.318	
5	.248	1.276	.316	.404	.013
Σ	1.779	$\bar{z}$ = .59	1.044	.837	.013

$I = .837 + .013 - .59 \times 1.044$
$= .850 - .616 = .234$

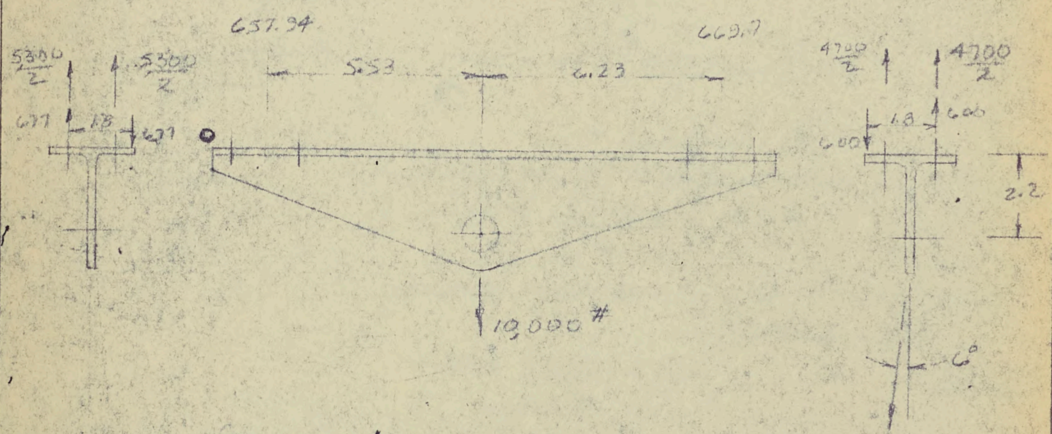
VQ/I SHEAR ON TEE ATTACHMENT TO PLATE
V = 7950 LBS.
Q = .86
$VQ/I = 7950 \times .86 / 2.06 = 3,300^{\#}/\text{IN.}$
2-ROWS BOLTS @ 1.25 APPROX.
SHEAR LOAD PER BOLT $= \dfrac{3300 \times 1.25}{2} = 2,060^{\#}$

FORM 1319A

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT No.	
		SHEET No. 5.06	
AIRCRAFT: C-105		PREPARED BY: McCABE	DATE: 3-10-56
		CHECKED BY:	DATE:

FUS. VERT. STRUT PICK-UP - STA 663.47
TENSION LOADS ON FLANGE

STRUT TENSION LOAD = 10,000# (PG. 5.03)



REACTIONS @ DIAPHRAGMS

$$\text{STA } 657.94 = \frac{10{,}000 \times 6.23}{11.76} = 5{,}300^{\#}$$

$$\text{STA. } 669.7 = 10{,}000 - 5300 = 4{,}700^{\#}$$

ASSUME STRUT LOAD CAN BE ECCENTRIC 6°, THEN, MOMENT DUE TO ECCENTRICITY WILL BE REACTED BY COUPLE LOADS AS SHOWN IN SKETCH.

$$\text{SIDE LOAD @ HOLE } \mathbb{C} = 10000 \sin 6° = 1{,}045^{\#}$$

$$\text{STA } 657.94 \text{ COUPLE LOADS} = \frac{1{,}045 \times 2.2}{1.8} \times \frac{6.23}{11.76} = 677^{\#}$$

$$\text{STA. } 669.7 \text{ COUPLE LOADS} = \frac{1045 \times 2.2}{1.8} \times \frac{5.53}{11.76} = 600^{\#}$$

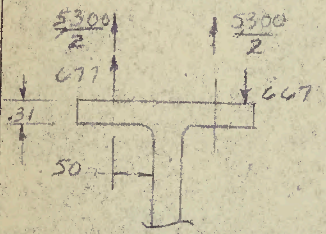
FORM 1319 A

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

AIRCRAFT: C-105		REPORT No.	
		SHEET No. 5.07	
		PREPARED BY: McCABE	DATE: 3-16-56
		CHECKED BY	DATE

FUS. VERT. STRUT PICK-UP ~ STA. 663.47

FLANGE BENDING



$$MOMENT = \left(\frac{5300}{2} + 677\right) .50$$

$$= 1,660 \text{ IN. LBS.}$$

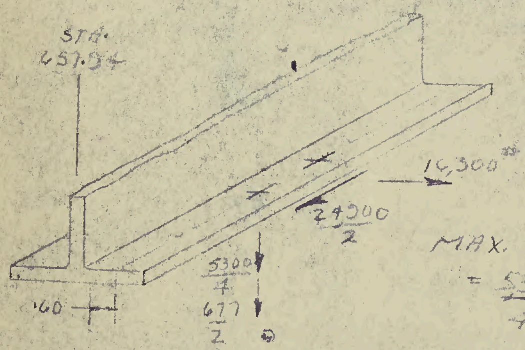
ASSUME 2" LENGTH OF FLG. EFFECTIVE

$$I/c = \frac{.31^2 \times 2.0}{6} = .032$$

$$ALLOW.\ MOMENT = 1.5 \times .032 \times 69,000$$
$$= 3,300 \text{ IN. LBS.}$$

$$M.S. = \frac{3,300}{1,660} - 1 = \quad .99\ M.S.$$

DIAPHRAGM FLANGE STRESSES (STA. 657.34)



FLANGE BENDING STRESS

MAX. BOLT TENSION LOAD

$$= \frac{5300}{4} + \frac{677}{2} = 1660\#$$

MAX. MOMENT FROM BOLT LOAD

$$= .60 \times 1,660 = 995 \text{ IN. LBS.}$$

ASSUME 1.5 IN. OF FLG. EFFECTIVE IN BENDING MOMENT, THEN

$$I/c = \frac{.25^2 \times 1.5}{6} = .0156$$

$$ALLOW.\ MOMENT = 66,000 \times .0156 \times 1.5$$
$$= 1,540 \text{ IN. LBS.}$$

FORM 1319A

FUS. VERT. STRUT PICK-UP ~ STA. 663.47

DIAPHRAGM FLANGE STRESSES

SHEAR STRESS

DIAPH. FLANGE LOAD 24,900# (PG. 2.05)

$$\text{MAX. SHEAR STRESS} = \frac{24,900}{2(7.8 \times .25)} \times \frac{3}{2}$$

$$= 9,600 \text{ PSI.}$$

$F_s = 45,000$ PSI.

TENSION STRESS

FOR CASE 8RQ TENSION STRESS IN FUS. BOX [illegible] SURFACE USE STRESS @ STA. [illegible] UPPER [illegible]

TENSION STRESS FOR CASE 8RQ = 6,670 PSI. (PG. 6.28)

LOAD IN INNER & OUTER [illegible] OVER LENGTH OF DIAPHRAGM [illegible] $= 6670(.188 + .125)7.8$
$= 16,300$ LBS.

ASSUME ENTIRE LOAD IS CARRIED IN DIAPH. FLANGE THEN,

$$f_t = \frac{16,300}{7.8 \times .25} = 8,400 \text{ PSI.}$$

MARGIN OF SAFETY

$R_B = .995/1540 = .65$
$R_S = 9600/45,000 = .21$
$R_t = 8400/66,000 = .13$

$$M.S. = \frac{1}{\left[(.65 + .13)^2 + .21^2\right]^{1/2}} - 1 = \quad \underline{.23 \text{ M.S.}}$$

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

AIRCRAFT: C-105		REPORT No.	
		SHEET No. 5.09	
		PREPARED BY	DATE
		McCABE	3-19-56
		CHECKED BY	DATE

FUS. VERT. STRUT PICK-UP - STA. 663.47

ATTACHMENT TO DIAPHRAGM FLANGE (1/4" Jo BOLTS)

CRITICAL ATTACHMENTS ARE @ STA. 669.

LOADS ON ATTACHMENTS

MAX. TENSION LOAD/BOLT FROM STRUT FITTING

$$= \frac{4700}{4} + \frac{600}{2}$$

$$= 1175 + 300 = 1475^{\#}$$

DIAPHRAGM LOAD, CASE RPO. = $45{,}900^{\#}$ (PG. 2.05)

SHEAR PER BOLT PER SHEAR FACE = $\frac{45{,}900}{2 \times 12}$

$$= 1{,}910^{\#}$$

LOAD FROM BENDING OF FIN BOX = $16{,}300^{\#}$ (PG. 5.08)

SHEAR PER BOLT PER SHEAR FACE = $\frac{16{,}300}{2 \times 6}$

$$= 1{,}360^{\#}$$

RESULTANT SHEAR = $(1{,}910^2 + 1{,}360^2)^{1/2}$
$= \underline{2340^{\#}}$

MARGIN OF SAFETY

$R_s = 2{,}340 / 4{,}100 = .57$

$R_t = 1{,}475 / 2{,}570 = .57$

$$M.S. = \frac{1}{(.57^2 + .57^2)^{1/2}} - 1 = \qquad \underline{.24\ M.S.}$$

ORM 1319A

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

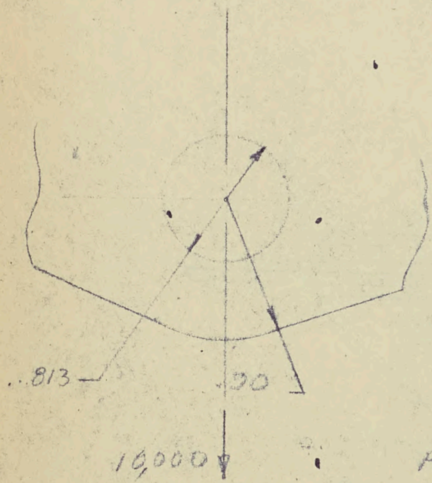
REPORT No.
SHEET No. 5.10

AIRCRAFT: C-105

PREPARED BY: McCABE | DATE:
CHECKED BY: | DATE:

FUS VERT. STRUT PICKUP - STA 6[illegible]3.42

LUG - SHEAR BEARING



LOAD ON LUG = 10,000 (TENS.)

$a = .90$

$D = .813$

$t = .36$

$a/D = .90/.813 = 1.1$

$D/t = .813/.36 = 2.26$

$A_{br} = .813 \times .36 = .293$

$K_{bru} = .98$

$F_{tux} = 69{,}000$

$P_{bru} = .98 \times 69{,}000 \times .293 = 19{,}800^{\#}$

$M.S. = \dfrac{19{,}800}{10000} - 1 =$ HIGH M.S.

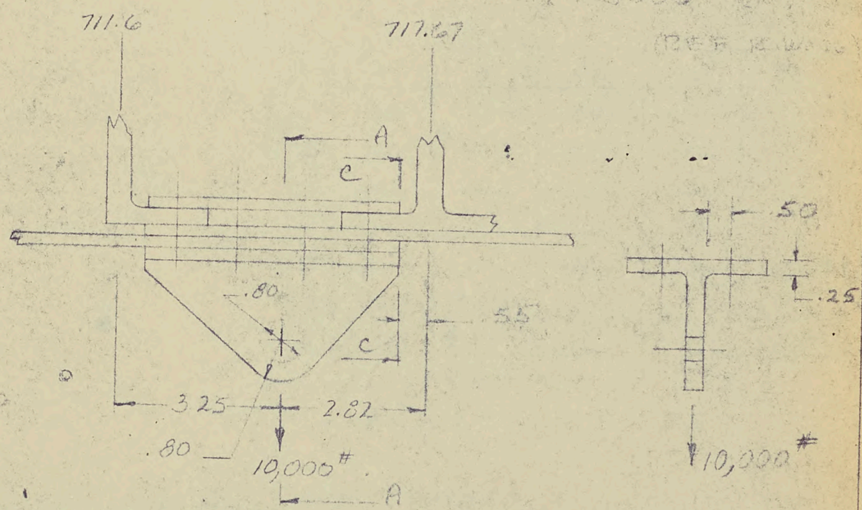
FORM 1319A

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	5.11
		PREPARED BY	DATE
		MCCABE	11-25-55
		CHECKED BY	DATE

FUS. STRUT PICK-UP — STA. 714.85

(- 1332 COMP.
+ 5000 TENS.
(REF. R.W.)



STRUT LOAD = 10,000 LBS. REF. WADC

REACTIONS & DIMENSIONS.

$$\text{STA } 711.6 = \frac{2.82 \times 10{,}000}{6.07} = 4{,}640 \text{ LBS.}$$

STA. 717.67 = 10,000 − 4640 = 5360 LBS.

LUG

$a = .80$ $\qquad a/D = .80/.80 = 1.0$

$w = 1.60$ $\qquad w/D = 1.60/.80 = 2.0$

$D = .80$ $\qquad D/t = .80/.31 = 2.56$

$t = .31$ $\qquad A_{br} = .80 \times .31 = .248$

$A_t = (1.60 - .80).31 = .248$

$K_{br} = .82$

$K_t = .70$

$P_{tu} = .70 \times 80{,}000 \times .248 = 13{,}900$ LBS.

$P_{bu} = .82 \times 64{,}000 \times .248 = 13{,}000$ LBS.

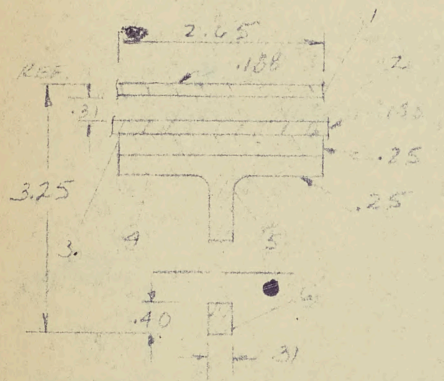
$$M.S. = \frac{13000}{10{,}000} - 1 = \underline{.30 \text{ M.S.}}$$

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

AIRCRAFT: C-105	REPORT NO.	
	SHEET NO. 5.12	
	PREPARED BY: McCABE	DATE: 11-28-55
	CHECKED BY	DATE

FUS. STRUT PICK-UP — STA. 714.85

SECTION PROPERTIES — SEC. A-A



ITEM	A	Z	AZ	AZ²	I₀
1	.501	.094	.049	.0046	
2	.501	.503	.236	.175	
3	.662	.810	.536	.435	
4	.662	1.060	.701	.742	
5	.263	1.660	.436	.724	.019
6	.124	3.05	.378	1.150	
Σ	2.713	$\bar{Z}$ = .88	2.336	3.2306	.019

$I = 3.2306 + .019 - .88 \times 2.336$
$= 3.32 - 2.10 = 1.22$

STRESSES SEC. A-A (PG. 5.11)

MOMENT = 3.25 × 4640 = 15,100 IN. LBS.

CRITICAL STRESSES ARE AT LUG SIDE OF N.A.

$f_b = \dfrac{15100 \times 1.37}{1.22} = 16,900$ PSI.

HOOP TENSION STRESS = $\dfrac{10,000}{2 \times .124} = 40,300$ PSI.

f_t (TOTAL) = 40,300 + 16,900 = 57,200 PSI.

F_t = 83,000

M.S. = $\dfrac{83,000}{57,200} - 1 =$ .45 M.S.

BENDING OF FITTING FLANGE

MOMENT = .50 × 10,000 / 2 = 2,500 IN. LBS.

ASSUME 4" OF FLG. EFFECTIVE

$I/c = .25^2 \times 4.0/6 = .0416$

$f_b = 2,500/.0416 = 66000$ PSI.

ALLOW. MOMENT = 1.5 × 64,000 × .0416 = 4000 IN. LBS.

M.S. = $\dfrac{4000}{2500} - 1 =$ .60 M.S.

FORM 1319A

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

REPORT No.		
SHEET No. 5.13		
AIRCRAFT: C-105	PREPARED BY McRAE	DATE 11-28-55
	CHECKED BY	DATE

FUS. STRUT PICK-UP – STA. 714.85

DIAPHRAGM FLG. BENDING (SEC. C-C) PG. 5.11

MOMENT ON FLG. = .55 × 5,360 = 2,940. IN. LBS.

ASSUME 2" OF FLG. EFFECTIVE

$I/C = .31^2 \times 2.0/6 = .032$

ALLOW. MOMENT = 1.5 × 71,000 × .032 = 3860 IN. LBS.

SHEAR STRESSES IN DIAPH. FLG. DUE TO FIN [illegible] WITH BENDING STRESSES

DIAPH. FLANGE LOAD = 52,000# (PG. 2.05)

FLG. SHEAR STRESS = $\frac{52,000}{2(5/x.31)} \times \frac{3}{2}$ = 24,600 PSI.

FS = 45,000 PSI.

MARGIN OF SAFETY

RB = 2,940/3860 = .76

RS = 24,600/45,000 = .55

$M.S. = \frac{1}{(.76^2 + .55^2)^{1/2}} - 1 =$ .07 M.S.

ATTACHMENTS (5/16 BLIND LOCKBOLTS)

BOLTS ARE LOADED BY TENSION LOAD FROM FITTING & SHEAR LOAD FROM DIAPHRAGM.

ASSUME 4-BOLTS EFFECTIVE IN CARRYING TENSION LOAD.

TENSION LOAD PER BOLT = 10,000/4 = 2500 LBS.

SHEAR LOAD PER BOLT FACE = $\frac{52000}{2 \times 8}$ = 3250 LBS.

ALLOW. TENSION LOAD = 3275#

ALLOW. SHEAR = .31 × .31 × 128,000/2 = 6150 LBS.

RS = 3250/6150 = .53

Rt = 2500/3250 = .77

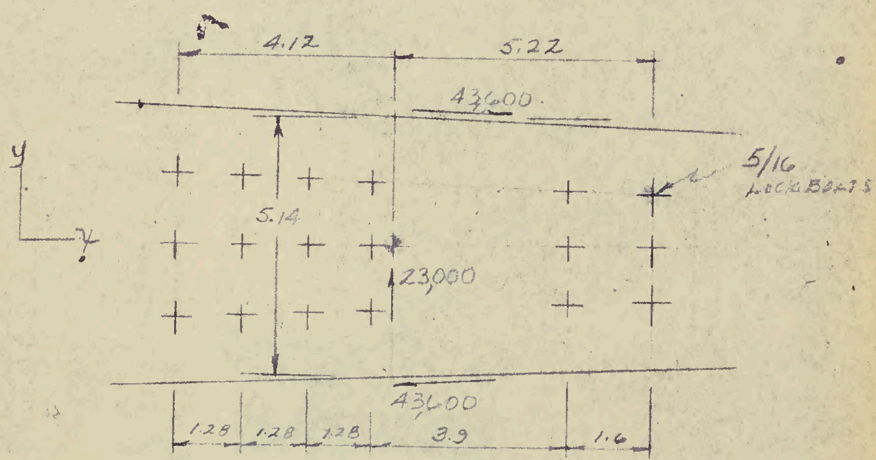
$M.S. = \frac{1}{(.53^2 + .77^2)^{1/2}} - 1 =$ .07 M.S.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	FIN ATTACHMENT TO FUSELAGE	REPORT No.	
		SHEET No. 5.14	
		PREPARED BY: McCABE	DATE: 3-4-55
		CHECKED BY:	DATE:

FIN REAR SPAR ATTACHMENT FITTING
ATTACHMENT TO UPPER SURFACE



FIN SKIN SHEAR = 7500 #/IN. (PG. 1.03)

SHEAR LOAD = $\frac{7500 \times 11.6}{2}$ = 43,600 LBS.

SIDE SHEAR FROM FIN SPAR = 23,000 LBS (7/0562/6, PG. 1.08)

MOMENT ON ATTACHMENTS = 43600 × 5.14 = 224,000 IN-LBS.

$\Sigma I_P = 221.3$

LOAD ON CRIT. BOLT FROM MOMENT

"y" COMPONENT = $\frac{224000 \times 5.22}{221.3}$ = 5,300 LBS.

"x" COMPONENT = $\frac{224000 \times 1.02}{221.3}$ = 1030 LBS.

LOAD PER BOLT FROM SIDE SHEAR = 23,000/18 = 1,280 LBS.

RESULTANT LOAD = $[(5300 + 1280)^2 + 1030^2]^{1/2}$

= 6,650 LBS

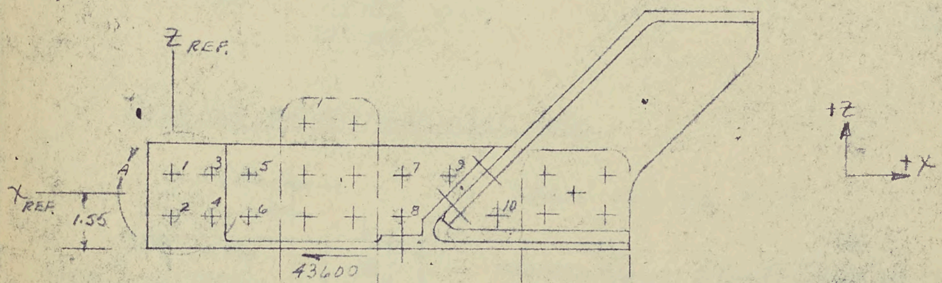
ALLOW. LOAD PER BOLT = 7,300 LBS.

M.S. = $\frac{7300}{6650} - 1$ = .10 M.S.

FORM 1319A

A.V. ROE CANADA LIMITED MALTON – ONTARIO TECHNICAL DEPARTMENT (Aircraft)	REPORT NO.	
	SHEET NO. 5.15	
	PREPARED BY: Mc CABE	DATE: 3-3-55
AIRCRAFT C-105 — FIN ATTACHMENT TO FUSELAGE	CHECKED BY:	DATE:

FIN REAR SPAR ATTACHMENT FITTING ATTACHMENT TO FIN SKIN



MOMENT @ CTR'D = 1.55 x 43,600
= 67,500 IN. LBS.

BOLT	X	Z	$\bar{X}_{NA} = \bar{X} - X$	X_{NA}^2	Z^2	VERT. COMP. $M/I \cdot X_{NA}$	HORIZ. COMP. $\frac{M}{I} \cdot Z + \Delta P_x$	RESULTANT $(\overline{VERT}^2 + \overline{HORIZ}^2)^{1/2}$
1	0	.52	3.36	11.3	.27	2450	-3380	4,650
2	0	–	3.36	11.3		2450	-4740	5250
3	1.05		2.31	5.3		1680	-3380	4,160
4	1.05	–	2.31	5.3		1680	-4740	5,030
5	2.02		1.34	1.8		980	-3380	4,080
6	2.02	–	1.34	1.8		980	-4,740	4,830
7	5.98		-2.62	6.9		-1910	-3380	4,400
8	5.98	–	-2.62	6.9		-1910	-4,740	5,100
9	7.20		-3.84	14.8		-2800	-3380	4,850
10	8.31	-.52	-4.95	24.5	.27	-3610	-4740	5,950
Σ	33.61			89.9	2.7			

$\bar{X} = 33.61/10 = 3.36$

$I_R = \Sigma X_{NA}^2 + \Sigma Z^2 = 89.9 + 2.7 = 92.6$ $\Delta P_x = -43650/10 = -4360$

$M/I_R = 67500/92.6 = 730$

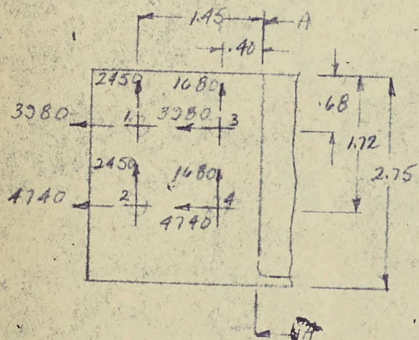
A.V.ROE CANADA LIMITED MALTON – ONTARIO TECHNICAL DEPARTMENT (Aircraft)	REPORT NO. – SHEET NO. 5.16 36
AIRCRAFT C-105 — FIN ATTACHMENT TO FUSELAGE	PREPARED BY: McCABE — DATE: 3-4-55 CHECKED BY: — DATE:

FIN REAR SPAR ATTACHMENT FITTING
ATTACHMENT TO FIN SKIN (CONT'D)

CRITICAL BOLT #10 = 5,950 LBS. (PG. 5.15)
ALLOW. LOAD 5/16 LOCKBOLT = 7300 LBS

$$M.S. = \frac{7300}{5950} - 1 = \qquad \underline{.23\ M.S.}$$

BENDING OF FITTING VERT. LEG



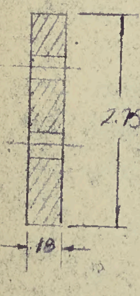
DETAIL A (PG. 5.15)

LOADS REF. PG. 5.15

MOMENT (A-A) = 2(1680 × .40 + 2450 × 1.45)
+ 2 × 4740 × .34 − 2 × 3980 × .69
= 2(672 + 3,550 + 1610 − 2740)
= 6180 IN. LBS.

f_b = 6180 / .228 = 27,000 PSI.

$$f_t = \frac{2(4740+3980)}{.36} = 48,500 \text{ PSI}$$



I/c = .228
A = .36

SEC. A-A

Mc/I = 108,000 REF. AVRO DESIGN MANUAL
ALLOW. MOM. = 108,000 × .228 = 24,600
R_b = 6180 / 24600 = .25
F_t = 77,000
R_t = 48,500 / 77,000 = .63

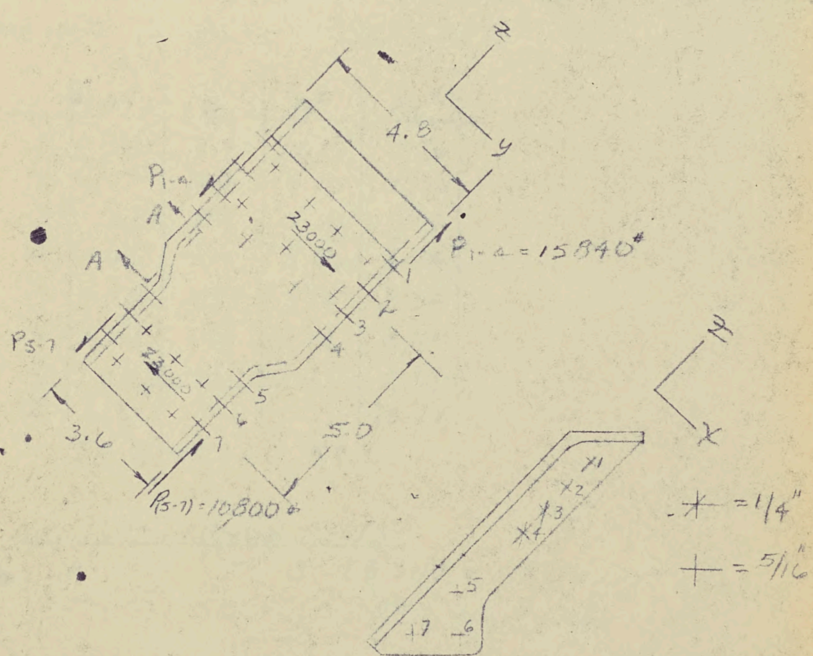
$$M.S. = \frac{1}{(.25+.63)} - 1 = \qquad \underline{.14\ M.S.}$$

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

AIRCRAFT: C-105		REPORT No.	
		SHEET No. 5.17	
		PREPARED BY: McCABE	DATE
		CHECKED BY	DATE

FIN REAR SPAR ATTACHMENT FITTING

REAR SPAR SHEAR = 23,000 # (PG 5.14)



ASSUME SPAR SHEAR LOAD AND ITS REACTION ACT AT CTR'D OF FITTING WEB BOLT GROUPS AS SHOWN IN SKETCH; THEN, THE MOMENT ON FITTING PRODUCED BY THE SHEAR COUPLE MAY BE REACTED BY BOLTS 1-7 IN FITTING FLANGES.

FORM 1319 A

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

REPORT NO.
SHEET NO 5.18

AIRCRAFT: C-105

PREPARED BY	DATE
McCABE	
CHECKED BY	DATE

FIN REAR SPAR ATTACHMENT FITTING

MOMENT OF INERTIA OF FLANGE BOLTS #1-7
ABOUT X-AXIS (REF SKETCH PG. 5.17)

	A	y	y^2	Ay^2
1	1.0	2.4	5.76	5.76
2	1.0	2.4	5.76	5.76
3	.65	2.4	5.76	3.74
4	.65	2.4	5.76	3.74
5	1.00	1.8	3.24	3.24
6	1.00	1.8	3.24	3.24
7	1.00	1.8	3.24	3.24
Σ	6.3			28.72

$I = 2 \times 28.72 = 57.5$

LOADS—FLANGE BOLTS

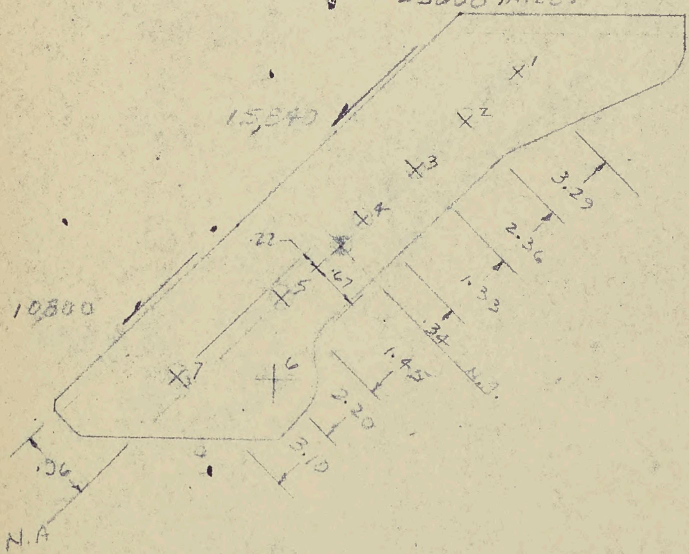
MOMENT = 5 × 23,000 = 115,000 IN. LBS
M/I = 115000/57.5 = 2000 LBS

	A	y	LOAD = $\frac{M}{I} \cdot A$	
1	1.0	2.4	4800	
2	1.0	2.4	4800	
3	.65	2.4	3120	
4	.65	2.4	3120	$\Sigma_{(1-4)}$ = 15,840 LBS.
5	1.00	1.8	3600	
6	1.00	1.8	3600	
7	1.00	1.8	3600	$\Sigma_{(5-7)}$ = 10,800 LBS.

FIN REAR SPAR ATTACHMENT FITTING
FLANGE ATTACHMENT LOADS

TOTAL LOAD ON FLG. = 15840 + 10800 (REF PG. 5.18)
= 26640#

MOMENT ON BOLTS = .96 x 26640
= 25600 IN. LBS



1.	2	3	4	5	6	7	8	9	10	11
	A	Z	X	AZ^2	AX^2	LOAD COMPONENT HORIZ. $-\frac{M}{I} Z.A$	VERT. $\frac{M}{I} X.A$	SHEAR VERT. COMP. (PG 5.18)	TOTAL VERT. = 8 + 9	RESULTANT $(7^2 + 10^2)^{\frac{1}{2}}$
1	1.0	3.29	.05	10.80	—	-2440	—	-4800	-4800	5560
2	1.0	2.36		5.58	—	-1750	—	-4800	-4800	5100
3	.65	1.33		1.15	—	-640	—	-3120	-3120	3150
4	.65	.34		.08	—	-163	—	-3120	-3120	3120
5	1.0	-1.45	.05	2.10	—	1070	—	-3600	-3600	3760
6	1.0	-2.20	.67	4.85	.45	1630	436	-3600	-3110	3500
7	1.0	-3.10	-.22	9.60	.05	2230	-163	-3600	-3763	4400
Σ	6.3			34.16	.50					

$I = 34.16 + .50 = 34.66$

$\frac{M}{I} = \frac{26640}{34.66} = 740$

BOLT #1 CRITICAL

$M.S. = \frac{7300}{5560} - 1 = .31$ M.S.

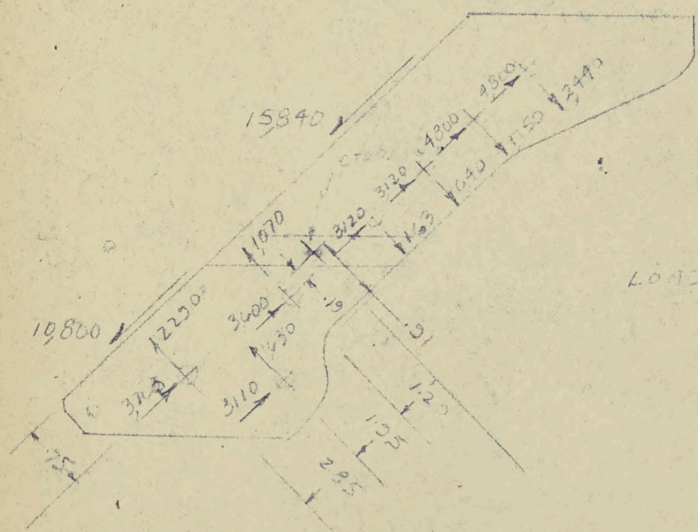
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	
SHEET NO	5.20

AIRCRAFT:		PREPARED BY	DATE
C-105		McCABE	1-13-56
		CHECKED BY	DATE

FIN REAR SPAR ATTACHMENT FITTING
FLANGE SHEAR STRESS

DUE TO JOGGLE IN FLANGE A TORSIONAL SHEAR STRESS IS INDUCED IN FLANGE AT JOGGLE

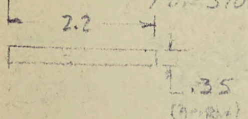


LOADS SEE PG. 5.19

MOMENT @ JOGGLE

2.85 × 2290 = 6,500	.75 × 10,800 = 8100
1.95 × 1630 = 3,180	.19 × 3,600 = 680
1.20 × 1070 = 1280	.91 × 3110 = 2830
10960	11,610

TORSIONAL MOMENT 11,610 - 10,960 = 650 IN.LBS



$$S_s = \frac{T}{ab^2}\left(3 + 1.8\frac{b}{a}\right)$$

$$= \frac{650}{2.2(.35)^2}\left[3 + 1.8\left(\frac{.35}{2.2}\right)\right]$$

$$= 2,420 \times 3.29$$

$$= 8000 \text{ PSI.}$$

RM 1319A

A. V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**	REPORT No.	
	SHEET No. 5.21	
AIRCRAFT: C-105	PREPARED BY: McCABE	DATE: 1-13-56
	CHECKED BY:	DATE:

FIN REAR SPAR ATTACHMENT FITTING
FLANGE SHEAR STRESS (CONT'D)

HORIZ. SHEAR = 2,290 + 1,630 + 1,070 (PG. 5.20)
= 4990#

SHEAR AREA = 1.7 x .20 = .34 IN.^{2} (APPROX.)

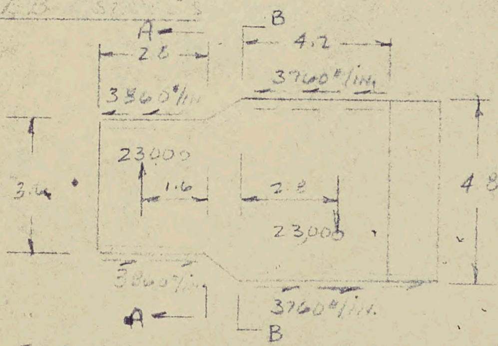
$f_s = \frac{4990}{.34} = 14,700$

TOTAL SHEAR = 14,700 + 8,000 = 22,700 PSI.

F_s = 45000 PSI.

M.S. = $\frac{45000}{22,700} - 1 =$ .98 M.S.

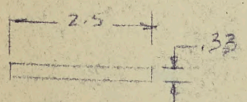
WEB STRESSES



FLANGE SHEAR FLOW
= 10800 / 2.8 = 3,860 #/IN.
& 15840 / 4.2 = 3,760 #/IN. } REF. PG. 5.20

SEC A-A STRESSES

MOMENT = 10,800 x 3.6 − 1.6 x 23,000
39,000 − 37,000 = 2,000 PSI.



SEC. A-A
(NEGLECTING FLANGES)

I/c = $\frac{2.5^2 \times .32}{6}$ = .33

f_b = 2,000 / .33 = 6,050 PSI. (NOT CRIT.)

$f_s = \frac{23,000}{.32 \times 2.5}$ = 28,800 PSI

F_s = 45,000

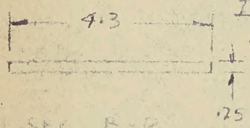
M.S. = $\frac{45000}{28800} - 1 =$ .56 M.S.

FORM 1319A

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

REPORT No.	
SHEET No.	5.22
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	1-13-56
CHECKED BY	
DATE	

FIN REAR SPAR ATTACHMENT FITTING
SEC. B-B STRESSES (PG. 5.21)



SEC. B-B

MOMENT $= 4.8 \times 15{,}800 - 2.8 \times 23{,}000$
$= 76{,}000 - 65{,}000 = 11{,}000$ IN.LBS.

$I/c = \dfrac{4.3^2 \times .25}{6} = .776$

$f_b = 11{,}000 / .776 = 14{,}200$ PSI. (NOT CRIT.)

$f_s = \dfrac{23{,}000}{4.3 \times .25} = 21{,}400$ PSI.

$F_s = 45{,}000$

$M.S. = \dfrac{45{,}000}{21{,}400} - 1$ HIGH M.S.

FORM 1319A

PART VI – AIR & INERTIA LOADS – FIN BOX STRUCT – STA. 624 – STA. 687

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	602
		PREPARED BY	DATE
		McCABE	
		CHECKED BY	DATE

AIR & INERTIA LOADS-FIN BOX STRUCT.- ST. 624 - STA. 687.

DESCRIPTION

IN ADDITION TO TRANSFERRING FIN ROLL LOADS TO THE WING STRUCTURE, THE FIN BOX ALSO CARRIES INERTIA & AIRLOADS FROM THE AFT FUSELAGE & FIN.

A PART OF THE AIR & INERTIA LOADS FROM THE AFT STRUCTURE IS BEAMED FORWARD BY THE FIN TO STA. 687, THEN, TRANSMITTED THROUGH THE FIN BOX, BETWEEN STA 624 & STA 687, TO THE WING STRUCTURE & ULTIMATELY REACTED BY EXTERNAL WING LOADS.

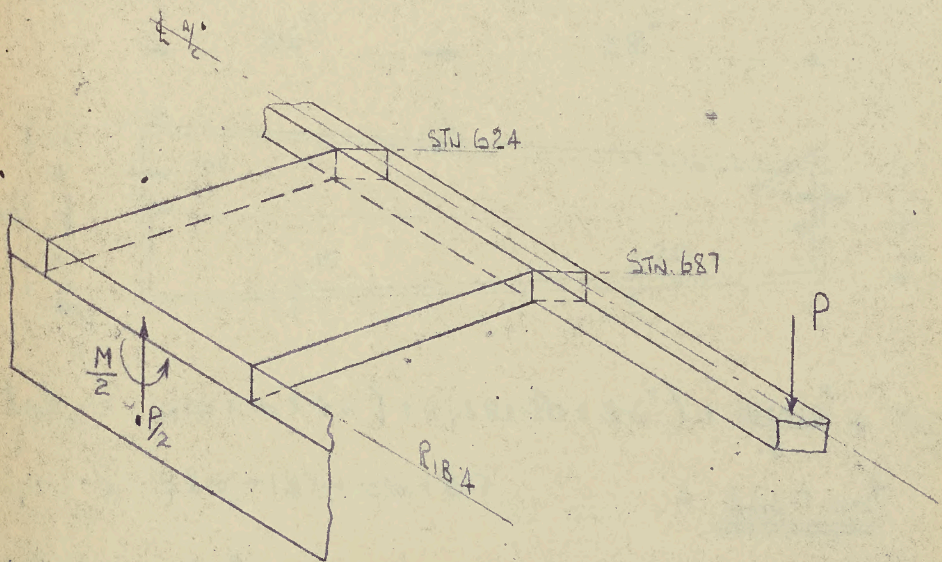
THE FOLLOWING ANALYSIS CONSIDERS THE DISPOSITION OF THE AIR & INERTIA LOADS RELATIVE TO THE FIN BOX STRUCTURE BETWEEN STA. 624 & STA 687.

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT NO.	
C-105		SHEET No 6.03	
		PREPARED BY	DATE
		P McGonigle	
		CHECKED BY	DATE

AIR & INERTIA LOADS - FIN BOX STRUCTURE - STA 624 - STA 687



THE ASSUMED WING TORQUE BOX FOR DISTRIBUTION OF LOAD P FROM STRUCTURE AFT OF REAR SPAR IS LOCATED BETWEEN STATIONS 624 AND 687, THE CENTRE REAR SPAR AND REAR SPAR RESPECTIVLY. THE LOAD P AND MOMENT M ARE REACTED HALF TO EITHER SIDE OF A/C. HENCE ONLY ONE HALF WILL BE CONSIDERED.

AS THIS ANALYSIS IS PURELY TO DETERMINE THE APPLICATION OF P. AND M. TO THE FIN BOX AND THE IMMEDIATE WING BOX REACTIONS, NO ACCOUNT WILL BE TAKEN OF THE SLOPE OF THE WING BOX AND ITS VARIATION IN SECTION CONSTANTS BETWEEN THE FIN BOX AND RIB 4.

FORM 1319A

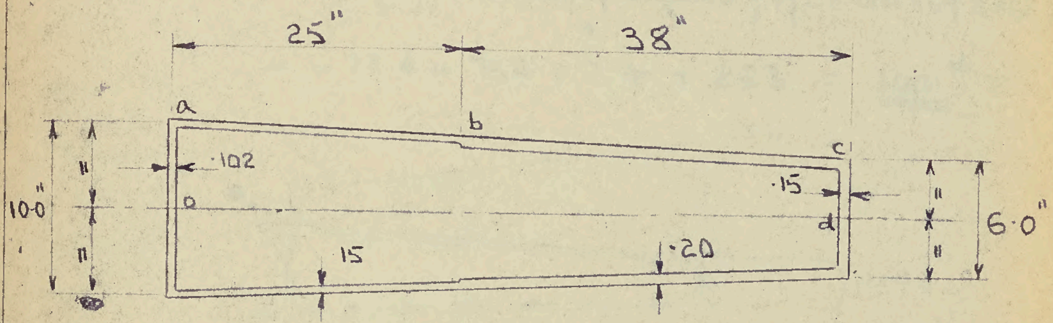
AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO	
SHEET NO.	6.04
AIRCRAFT:	C105
PREPARED BY	P McKenzie
DATE	
CHECKED BY	
DATE	

AIR & INERTIA LOADS - FIN BOX STRUCTURE ~ STA 624 - STA 687

SECTION THROUGH WING TORQUE BOX AT ITS JOINT WITH FIN BOX



$$I_{od} = 2(25 \times .15 \times 4.6^2) + 2(38 \times .20 \times 3.6^2) + \frac{.102 \times 10^3}{12} + \frac{.15 \times 6^3}{12}$$

$$= 158.5 + 197 + 8.5 + 2.7 \qquad = \underline{\underline{366.7 \text{ INS}^4}}$$

FOR $V = 1000^{\#}$ $\quad \frac{V}{I} = \frac{1000}{366.7} = \underline{\underline{2.73}}$

FLEXURAL SHEAR FLOW

ASSUME $q_o = 0$

$$\therefore \quad q_a = 0 + \frac{V}{I}\sum_o^a ZA$$

$$q_a = 0 + (2.73 \times .102 \times \frac{10}{2} \times \frac{10}{4}) = \underline{4.0}\ ^{\#/''}$$

$$q_b = 4.0 + (2.73 \times .15 \times 25 \times 4.6) = \underline{51.0}\ ^{\#/''}$$

$$q_c = 51 + (2.73 \times .20 \times 38 \times 3.6) = \underline{125.6}\ ^{\#/''}$$

$$q_d = 125.6 + (2.73 \times .15 \times \frac{6}{2} \times \frac{6}{4}) = \underline{127.45}\ ^{\#/''}$$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

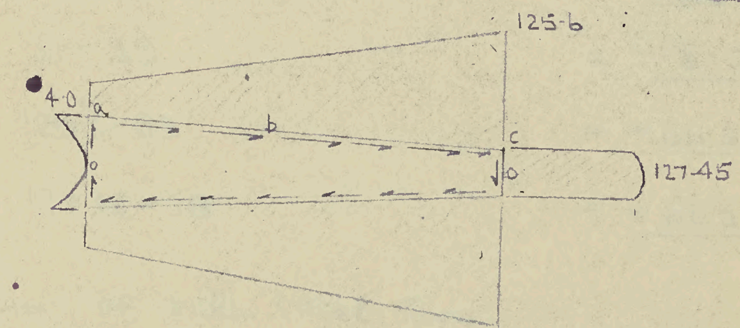
AIRCRAFT:		REPORT No	
		SHEET No	605
		PREPARED BY	DATE
		P McKenzie	
		CHECKED BY	DATE

AIR & INERTIA LOADS ~ FIN BOX STRUCTURE - STA 624 - STA 687

CHECK:

$$\Sigma V_z = 1000 = -\left(\frac{4\times10}{3}\right)+(125\cdot6\times6)+\left(\frac{2\times1\cdot85\times6}{3}\right)+(2\times\cdot031\times64\cdot8\times63)$$

$$= -13\cdot4 + 754 + 7\cdot4 + 253 = \underline{\underline{1001^{\#}}}\ \checkmark$$



TOTAL SHEAR STRAIN DUE TO THIS SHEAR FLOW.

TAKING G AS CONSTANT AND EQUAL TO UNITY

$$\Sigma\sigma = \Sigma\frac{qL}{t}$$

$$= 2\left[\frac{4\times5}{3\times\cdot102}+\frac{28\times25}{\cdot15}+\frac{88\times38}{\cdot20}+\frac{125\cdot6\times3}{\cdot15}+\frac{1\cdot85\times3\times2}{3\times\cdot15}\right]$$

$$= 2[65\cdot4 + 4670 + 16710 + 2512 + 23] = \underline{\underline{47960}}$$

FOR CONDITION OF NO TWIST A CONSTANT SHEAR FLOW q #/" WHICH WILL PRODUCE A SHEAR STRAIN OF − 47960 MUST BE APPLIED TO BOX. VIZ.

$$\Sigma\sigma_L = 2\left[\frac{q\times5}{\cdot102}+\frac{q\times25}{\cdot15}+\frac{q\times38}{\cdot2}+\frac{q\times3}{\cdot15}\right] = -47960$$

$$\therefore q = \frac{-47960}{812\cdot2} = \underline{\underline{-59\cdot0^{\#/"}}}$$

FORM 1319A

AIR & INERTIA LOADS - FIN BOX STRUCTURE - STA 624 - STA [illegible]

RESULTANT SHEAR FLOW

$q_o = 0 - 59 \qquad = \underline{-59.0}\ ^{\#/''}$

$q_a' = 4 - 59 \qquad = \underline{-55.0}\ ^{\#/''}$

$q_b = 51 - 59 \qquad = \underline{-8.0}\ ^{\#/''}$

$q_c = 125.6 - 59 \qquad = \underline{+66.6}\ ^{\#/''}$

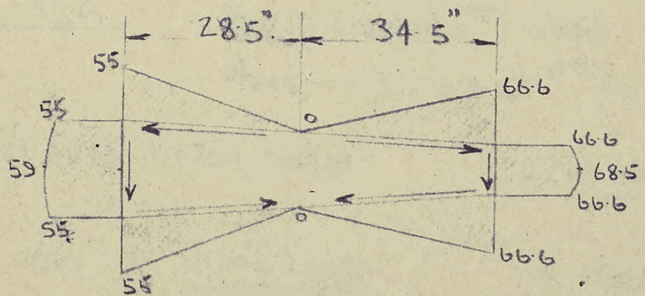
$q_d = 127.45 - 59 \qquad = \underline{+68.5}\ ^{\#/''}$

FOR LOCATION OF ZERO SHEAR FLOW.

$$\left(4.0 + \frac{121.6x}{63}\right) = 59$$

$$x = \frac{63 \times (59-4)}{121.6} \qquad = \underline{28.5''}$$

FLEXURAL SHEAR FLOW FOR 1000# APPLIED AT SHEAR CENTRE



SHEAR CENTRE $= \dfrac{\Sigma M_o}{\Sigma V}$ MOMENTS ABOUT O

$$= \frac{67.8 \times 6 \times 63 + 66.6 \times 34.5 \times 5 - 55 \times 28.5 \times 5}{1000}$$

$$= \frac{29250}{1000} \qquad = \underline{29.25''}$$

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.
SHEET NO. 6.07

AIRCRAFT: C-105

PREPARED BY: P. McIlgorm | DATE
CHECKED BY | DATE

AIR & INERTIA LOADS - FIN BOX STRUCTURE - STA 624 - STA 687

CHECK ON TOTAL SHEAR

$$\Sigma V = 1000 = (67.8 \times 6) + (5.8 \times 10) + (.0318 \times 66.6 \times 34.5) - (.0318 \times 54 \times 28.5)$$

$$= 409 + 580 + 64.7 - 56 = \underline{997.7^{\#}}$$ ✓

FUSELAGE STATION AT SHEAR CENTRE

$$= 624 + 29.25 = \underline{653.25}$$

FROM REPORT No. PP

THE SHEAR AND MOMENT FOR VARIOUS CASES ARE QUOTED AT STATION 655. THEREFORE THE MOMENT AT STATION 650.9

$$= M_{655} + 4.1 V_{655}.$$

CASE A-3-a

$V_{655} = 20\,000^{\#}$ / SIDE

$M_{655} = 1.3075 \times 10^6$ #" / SIDE

$$M_{SC.} = (1.3075 + 1.75 \times .02)10^6 = \underline{1.3425 \times 10^6}$$

$$\text{AREA OF BOX} = \frac{(10+6)\,63}{2} = \underline{504^{\square''}}$$

$$\text{BATHO SHEAR FLOW } q = \frac{T}{2A}$$

$$= \frac{1.3425 \times 10^6}{2 \times 504} = \underline{\underline{1335^{\#}/''}}$$

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	
SHEET NO.	6.08
AIRCRAFT:	C-105
PREPARED BY	P McKenzie
DATE	
CHECKED BY	
DATE	

AIR & INERTIA LOADS - FIN BOX STRUCTURE STA 624 - STA 657

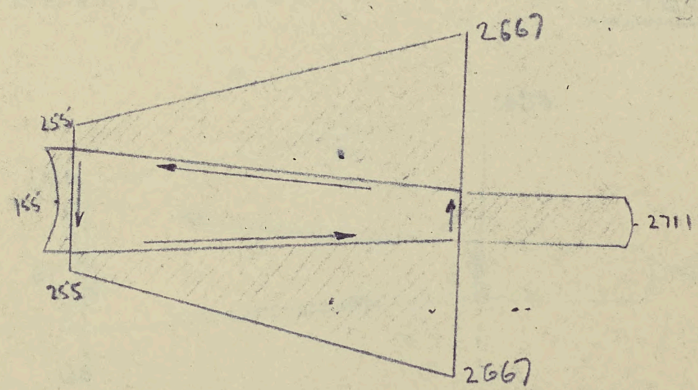
TOTAL SHEAR FLOW - CASE 11-3-a

$q_a = 59 \times 20 - 1335 = \underline{-155}$ #/"

$q_b = 54 \times 20 - 1335 = \underline{-255}$ #/"

$q_c = -66.6 \times 20 - 1335 = \underline{-2667}$ #/"

$q_d = -68.8 \times 20 - 1335 = \underline{-2711}$ #/"



R.B.D CASE 22

$V_{655} = 13000$ #/SIDE

$M_{655} = .8106 \times 10^6$ #"/SIDE

$M_{s.c} = (.8106 + 1.75 \times .013)10^6 = \underline{.8639 \times 10^6}$ #"

$q = \dfrac{.8344 \times 10^6}{1008} = \underline{828}$ #/"

FORM 1319A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105		REPORT NO.	
		SHEET NO. 609	
		PREPARED BY P McKenzie	DATE
		CHECKED BY	DATE

AIR & INERTIA LOADS — FIN BOX STRUCT. — STA 674 - STUB

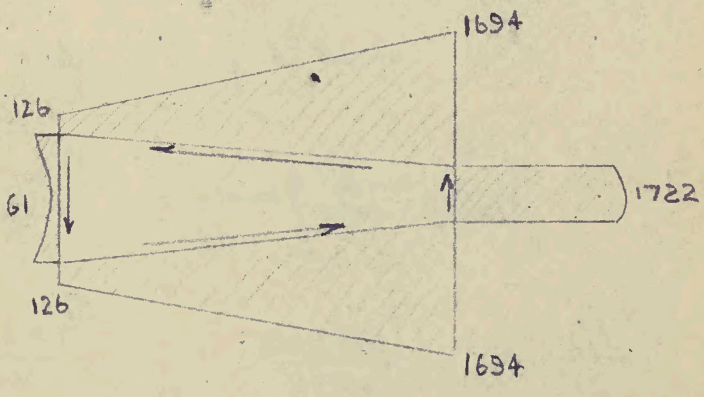
TOTAL SHEAR FLOW RPD CASE 22

$q_o = 59 \times 13 - 828 = \underline{-61.0}$ #/"

$q_a = 54 \times 13 - 828 = \underline{-126.0}$ #/"

$q_c = -66.6 \times 13 - 828 = \underline{-1694.0}$ #/"

$q_d = -68.8 \times 13 - 828 = \underline{-1722.0}$ #/"



DISTRIBUTION OF SHEAR AND MOMENT TO FIN BOX.

SHEAR AND MOMENT IS APPLIED TO THE FIN BOX BY THE INFINITELY STIFF FIN SKIN AND IS REACTED BY THE ELASTIC TORSION BOX WHICH HAS A VARYING FLEXURAL STIFFNESS BETWEEN SPARS. FOR THE PURPOSE OF MAXIMUM FINGER PLATE LOADING A TRIANGULAR STIFFNESS OF WING BOX IS ASSUMED

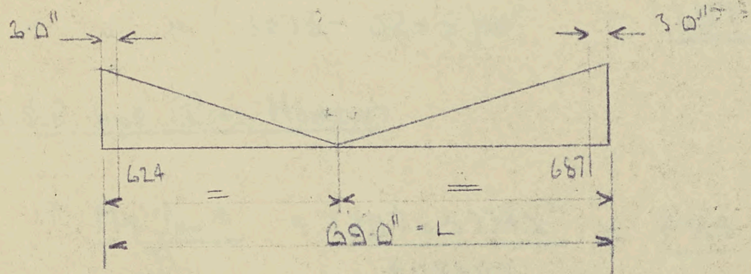
FORM 1318A

AVRO AIRCRAFT LIMITED
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C-105	REPORT NO.
	SHEET NO 6.10
PREPARED BY P McKenzie	DATE
CHECKED BY	DATE

AIR & INERTIA LOADS - FIN BOX STRUCT - STA 624 - STA 687

FIN SKIN WILL ALSO BE CONSIDERED FOR 3.0" EITHER SIDE OF SPARS TO GIVE MAXIMUM FINGER LOAD AT SPARS.



$$I = \int_{-L/2}^{L/2} x^2\,da = \int_{-L/2}^{L/2} x^3 \operatorname{Tan}\alpha\,dx$$

$$= \operatorname{Tan}\alpha\left[\frac{x^4}{4}\right]_{-L/2}^{L/2} = \operatorname{Tan}\alpha\left(\frac{L^4}{2^4\times 4} + \frac{L^4}{2^4\times 4}\right)$$

$$= \frac{2\operatorname{Tan}\alpha\, L^4}{64} = \frac{2\times 2BL^4}{64\times L} = \frac{BL^3}{16}$$

$$I = \frac{.5774\times L^4}{32} = \frac{.5774\times 69^4}{32} = \underline{408800 \text{ ins}^4}$$

LOADING PER INCH FROM MOMENT AT ANY POINT

$$= \frac{M x A}{I} = \frac{M x^2 \tan\alpha}{I}$$

LOADING PER INCH FROM SHEAR AT ANY POINT

$$= \frac{V\,da}{A} = \frac{V x \tan\alpha\,dx}{A} = \frac{4Vx}{L^2}$$

FORM 1319A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.	
SHEET NO.	6.11
PREPARED BY	[illegible]
DATE	
CHECKED BY	
DATE	

AIRCRAFT: C-105

AIR & INERTIA LOADS - FIN BOX STRUCTURE - STA.624 - STA.687

CASE II 3 a

SHEAR AT MID BOX (STN. 655.5) $= 20000$ #/SIDE

MOMENT " " " $(1.3073 - .02 \times .5)10^6 = 1.297$ #/" $\times 10^6$

LOADING PER INCH FROM MOMENT

$$W_m = \frac{Mx^2 \tan\alpha}{I} = \frac{1297 \times .5774 x^2}{408800} = 1.84 x^2 \ \#/''$$

LOADING PER INCH FROM SHEAR

$$W_v = \frac{4Vx}{L^2} = \frac{4 \times 20000 \times x}{69^2} = 16.8 x \ \#/''$$

MEASURED FROM MID BEAM

1	2	3	4	5
x	x^2	$1.84x^2$	$16.8x$	(3) + (4)
34.5	1190	± 2190	580	+ 2770 - 1610
30.5	930	± 1712	512	+ 2240 - 1200
25.5	650	± 1195	428	+ 1623 - 767
20.5	430	± 791	344	+ 1135 - 447
15.5	240	± 442	260	+ 707 - 182
10.5	110	± 202	177	+ 379 - 25
5.5	30	± 55	92	+ 147 + 37

FORM 1319A

AVRO AIRCRAFT LIMITED

TECHNICAL DEPARTMENT (Aircraft)

REPORT No.

SHEET No. 6.12

AIRCRAFT: C-105

PREPARED BY: P Mckenzie | DATE:

CHECKED BY: | DATE:

AIR & INERTIA LOADS - FIN BOX STRUCT STA. 624 - STA. 687

R.P. Q. CASE 22

SHEAR AT MID BOX (STA. 655.5) = 13000#/SIDE

MOMENT " " " $= (8106 - .013 \times .5)10^6$ = $8041"\# \times 10^6$

LOADING/INCH FROM MOMENT

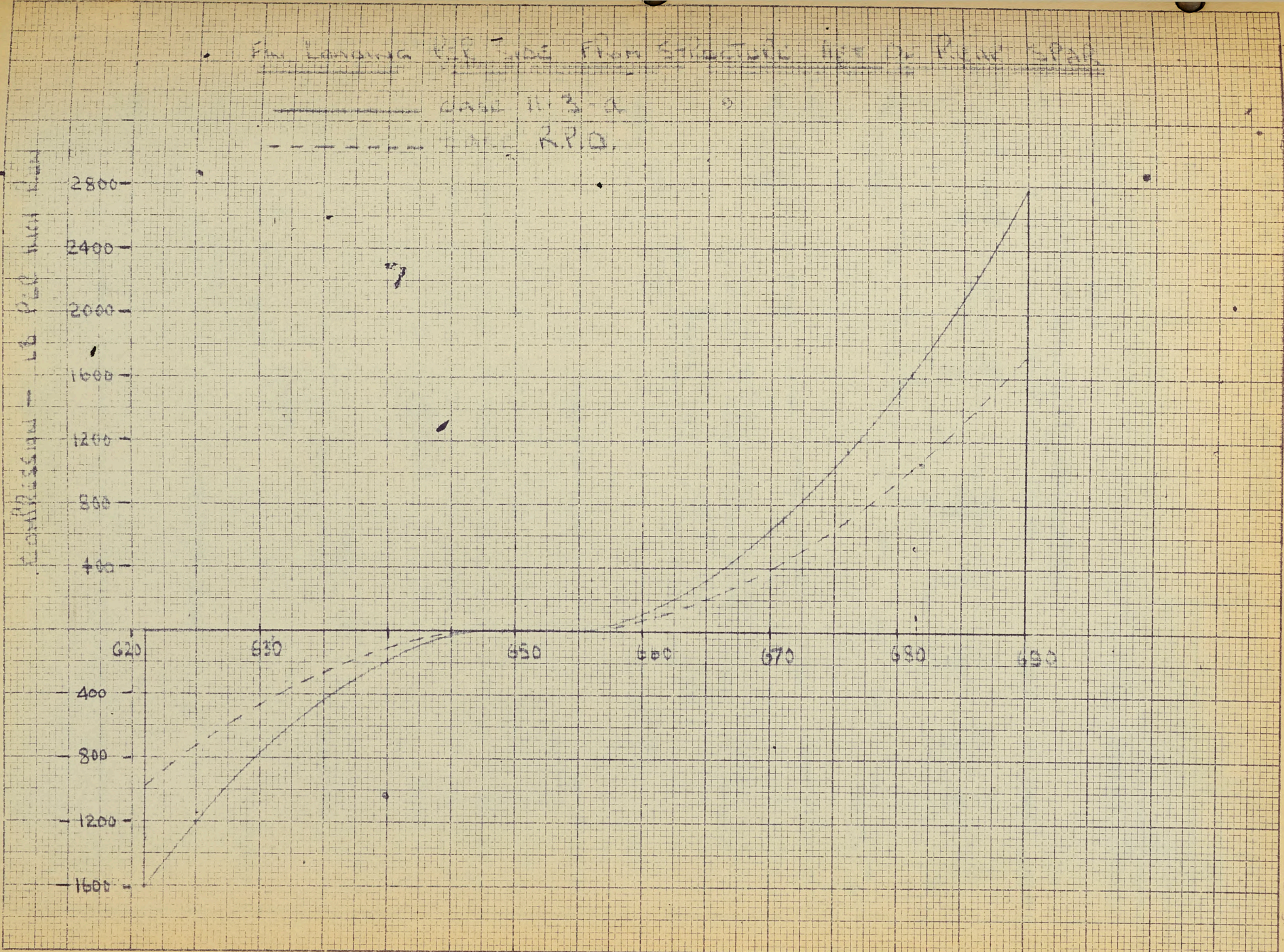
$$W_M = \frac{Mx^2 \tan a}{I} = \frac{.8041 \times 10^6 \times .577 \times x^2}{408800} = 1.135x^2$$

LOADING/INCH FROM SHEAR

$$W_V = \frac{4Vx}{L^2} = \frac{4 \times 13000 \times x}{69^2} = 10.9x$$

1	2	3	4	5
x	x^2	$1.135x^2$	$10.9x$	(3) + (4)
34.5	1190	± 1350	376.0	+ 1726 − 974
30.5	930	± 1055	333.0	+ 1388 − 722
25.5	650	± 738	278.0	+ 1016 − 460
20.5	430	± 488	224.0	+ 712 − 264
15.5	240	± 272	169.0	+ 441 − 103
10.5	110	± 125	115.0	+ 240 − 10
5.5	30.	± 34	60.0	+ 96 + 26

FORM 319A



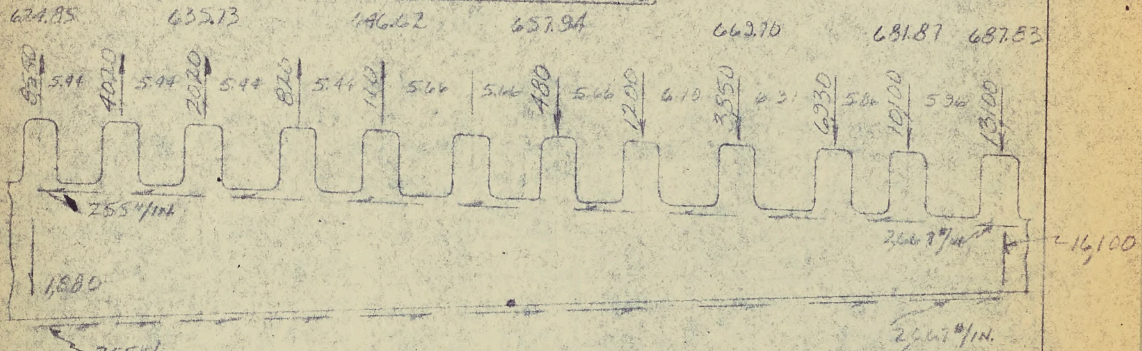
2800
2400
2000
1600
1200
800
400
620
630
650
660
670
680
690
400
800
1200
1600

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

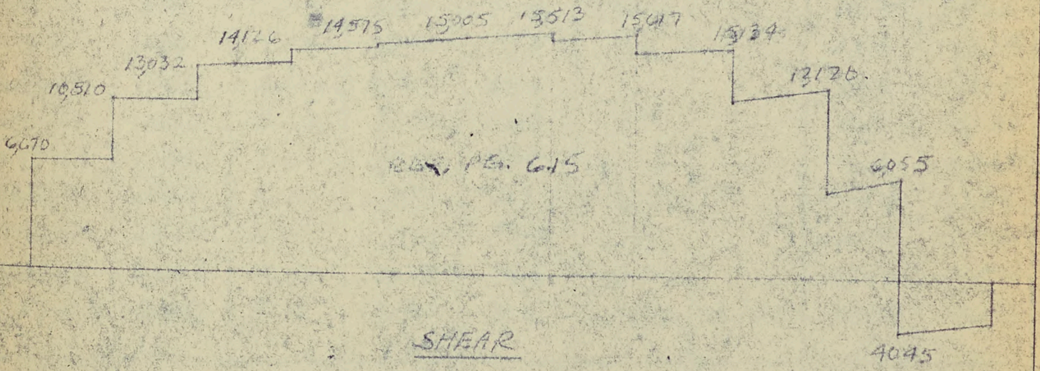
REPORT NO.
SHEET NO. 6.14

AIRCRAFT:		PREPARED BY	DATE
C-105		McCABE	9-29-55
		CHECKED BY	DATE

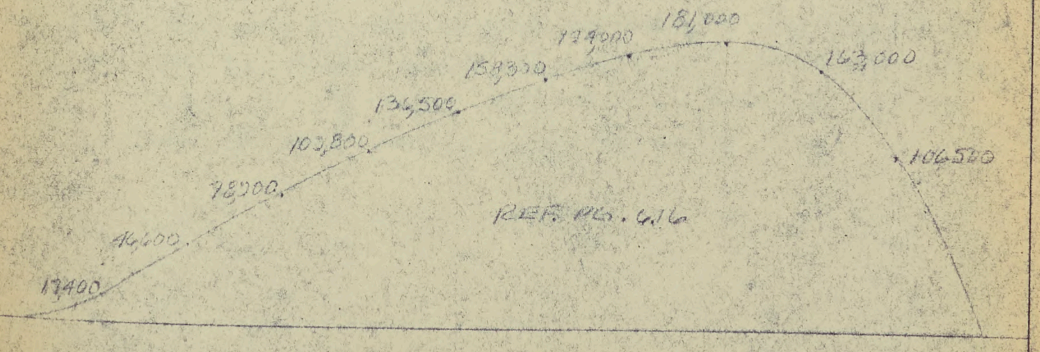
AIR & INERTIA LOADS ~ FIN BOX STRUCTURE ~ STA 624 - STA 687
CASE 11 B a
SHEAR & MOMENT DIAGRAMS



LOADS FROM CURVE PG. 6.13, ARE DISTRIBUTED TO FIN BOX FINGERS FINGERS. FOR FIN BOX SHEARS REF. PG. 6.08



SHEAR



MOMENT

FORM 1319A

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

REPORT No.

SHEET No. 6.15

AIRCRAFT: C-105

PREPARED BY	DATE
McCABE	10-5-55
CHECKED BY	DATE

AIR & INERTIA LOADS — FINBOX STRUCTURE — STA. 624 - STA. 687

CASE 11 (3) a

VERTICAL SHEAR

1	2	3	4	5	6	7	8	9
STA.	q #/IN.	d	AVG SHEAR LOAD = $\frac{(q_n + q_{n-1})d}{2}$	LOAD VERT. COMPONENT $2(4)\frac{2}{63}$	FINGER LOAD	LOAD @ SPARS	TOTAL LOAD = 5 + 6 + 7	SHEAR (Σ 8)
	PG. 6.14	PG. 6.14			PG. 6.14	PG. 6.14		
624.85	255				8,550	-1,880	6670	6670
630.29	463	5.44	1,950	124	4020		4144	10,810
635.73	709	5.44	3,180	202	2,020		2222	13,032
641.17	878	5.44	4,310	274	820		1094	14,126
646.62	1,086	5.44	5,340	339	110		449	14,575
652.28	1,305	5.66	6,760	430			430	15,005
657.94	1,520	5.66	8,000	508	-480		28	15,033
663.60	1,735	5.66	9,200	584	-1,200		-616	14,417
669.70	1,965	6.10	11,300	717	-3,850		-3133	11,284
676.01	2,210	6.31	13,190	836	-6,930		-6,094	5,190
681.87	2,435	5.86	13,610	865	-10,100		-9,235	-4,095
687.83	2,667	5.96	15,200	965	-13,100	16,120	3,965	0

VERTICAL SHEAR LOADS ARE COMPUTED BY SUMMING UP SHEAR FLOW VERT. COMPONENT, FINGER LOADS, & SHEAR AT [illegible]. THE FINAL SHEAR LOADS IN COL. 9 ARE PLOTTED ON PG. 6.14

FORM 1319A

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	6.16
		PREPARED BY	DATE
		McCABE	10-5-55
		CHECKED BY	DATE

AIR & INERTIA LOADS FIN BOX STRUCTURE - STA.624 - STA.681

CASE 11 (5) a

MOMENTS

1	2	3	4	5	6	7	8	9	10
STA.	d	h	VERT. SHEAR	ΔM = d × V_{n-1}	ΣΔM	HORIZ. SHEAR LOAD	ΔM = H × 7	ΣΔM	TOTAL MOMENT 6 + 9
	PG. 6.14	PG. 6.04	PG. 6.15			PG. 6.15			
624.35			6670		0		0	0	0
630.29	5.44	3.65	10810	36200	36200	1,950	18,800	-18,800	17400
635.73	5.44	3.31	13632	58800	95000	3180	29,600	-48,400	46600
641.17	5.44	8.36	14126	70900	165900	4,310	38,600	-87,000	78,900
646.62	5.44	8.62	14575	76,900	242800	5340	46,000	-133000	109,800
652.28	5.66	8.26	15005	82,500	325300	6,760	55,800	-188800	136,500
657.94	5.66	7.90	15033	85,000	410300	8,000	63,200	-252,000	158,300
663.00	5.66	7.54	14417	85100	495400	9,200	[illegible]	-321,400	174000
668.70	6.10	7.16	11284	88,000	583400	11,300	81,000	-402,400	181,000
676.01	6.31	6.66	5190	71,100	659,500	13,100	89,100	-491,500	163,000
681.87	5.36	6.38	-4045	30,400	684,300	13,610	86,900	-578,400	166500
681.83	5.36	6.00	0	-24100	665,800	15,200	91,200	[illegible]	0

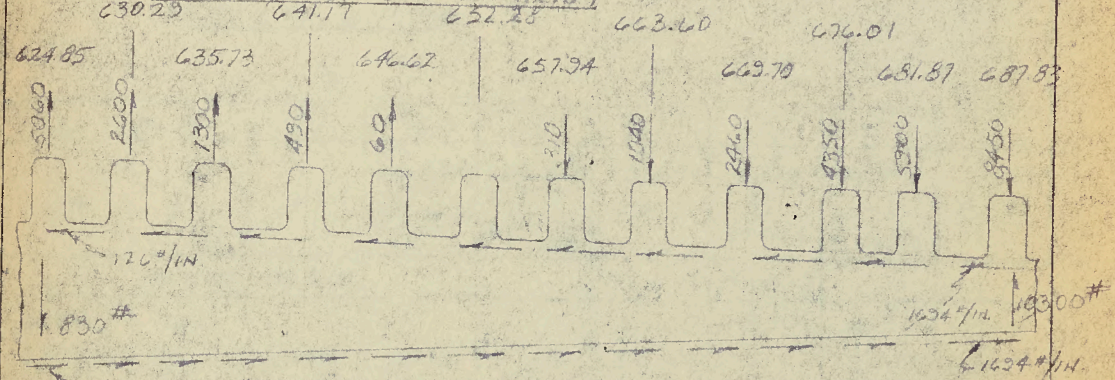
FIN BOX BENDING MOMENTS ARE COMPUTED FROM SHEAR FLOWS & FINGER LOADS SHOWN IN SKETCH ON PG. 6.14
A BENDING MOMENT DIAGRAM PLOTTED FROM LOADS IN COL. 10 IS ALSO INCLUDED ON PG. 6.14

FORM 1319A

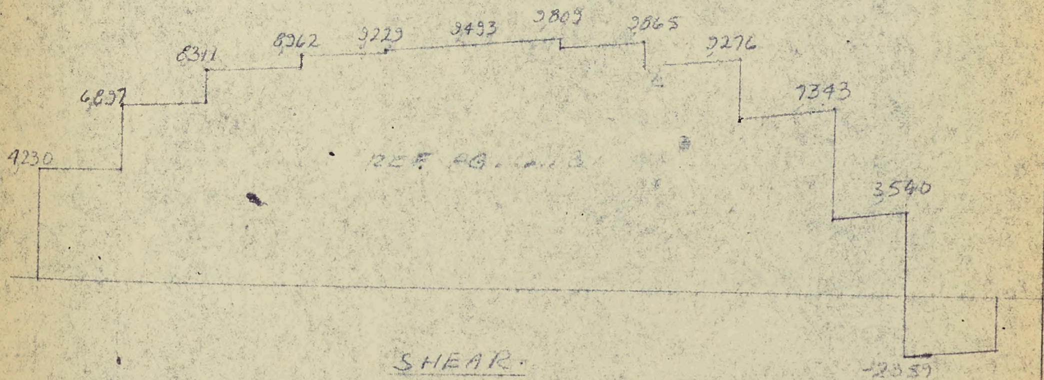
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	6.17
		PREPARED BY	DATE
		McCABE	10-6-55
		CHECKED BY	DATE

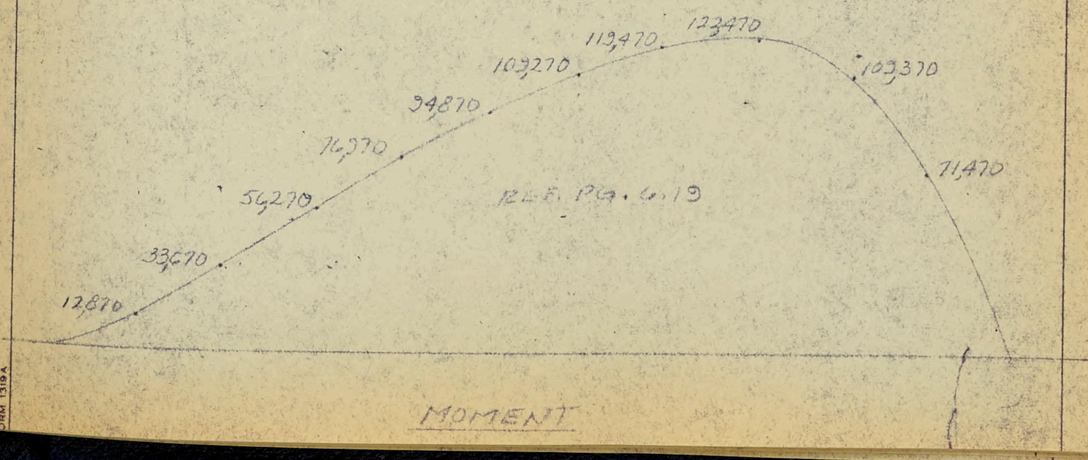
AIR & INERTIA LOADS—FIN BOX STRUCTURE—STA 624-STA 687
CASE 22
SHEAR & MOMENT DIAGRAM



LOADS FROM CURVE PG. 6.13 ARE DISTRIBUTED TO FIN BOX FINGERS ABOVE. FOR FIN BOX SHAPES REF. PG. 6.09



SHEAR.



MOMENT

FORM 1319A

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

REPORT NO.
SHEET NO. 6.18

AIRCRAFT: C-105

PREPARED BY	DATE
McCABE	10-13-55
CHECKED BY	DATE

AIR & INERTIA LOADS – FIN BOX STRUCTURE – STA. 624 – STA 687
CASE 22
VERTICAL SHEAR

1	2	3	4	5	6	7	8	9
STA.	q #/IN	d	AVG SHEAR LOAD = $\frac{(q_n+q_{n-1})d}{2}$	LOAD VERT. COMPONENT $2 \cdot (4) \cdot \frac{2}{63}$	FINGER LOAD	LOAD @ SPARS	TOTAL LOAD 5+6+7	SHEAR Σ (8)
	PG 6.09	PG. 6.14			PG. 6.17	PG. 6.17		
624.85	126				5,000	-830	4,230	4,230
630.29	261	5.44	1,050	67	2,600		2,[illegible]67	6,897
635.73	397	5.44	1,790	114	1,300		1,414	8,311
641.17	533	5.44	2,525	161	400		[illegible]51	8,962
646.62	666	5.44	3,260	207	60		267	9,229
652.28	808	5.66	4,150	264			264	9,493
657.94	949	5.66	4,970	316	-310		6	9,499
663.60	1,090	5.66	5,760	366	-1,040		-674	8,825
669.70	1,238	6.10	7,100	451	-2,460		-2,009	6,816
676.01	1,397	6.31	8,300	527	-4,[illegible]		-3,823	2,993
681.81	1,546	5.86	8,630	548	-5,[illegible]		-5,252	-2,359
687.83	1,694	5.[illegible]	9,660	614	-8,450	10,300	2,464	0

VERTICAL SHEAR LOADS ARE COMPUTED BY SUMMING UP SHEAR FLOW VERT. COMPONENT, FINGER LOADS, & SHEAR AT SPARS. THE FINAL SHEAR LOADS IN COL 9, ARE PLOTTED ON PG. 6.17

FORM 1319A

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

AIRCRAFT: C-105

REPORT No.
SHEET No. 6.19

PREPARED BY: McCABE · DATE: 10-13-53
CHECKED BY: DATE:

AIR & INERTIA LOADS ~ FIN BOX STRUCTURE - STA. 624 - STA. 687

CASE 22

MOMENTS

1	2	3	4	5	6	7	8	9	10
STA.	d	h	VERT. SHEAR	$\Delta M_1 = d \times (4)_{n-1}$	$\Sigma \Delta M_1$	HORIZ. SHEAR LOAD	$\Delta M_2 = h \times (7)$	$\Sigma \Delta M_2$	TOTAL MOMENT (6) + (9)
	PG. 6.14	PG. 6.04	PG. 6.19			PG. 6.18			
624.85			4230		0		0	0	0
630.29	5.44	9.65	6897	23,000	23,000	1050	10,130	-10,130	12,870
635.73	5.44	9.31	8311	37,500	60,500	1790	16,700	-26,830	33,670
641.17	5.44	8.96	8962	45,200	105,700	2,525	22,600	-49,430	56,270
646.62	5.44	8.62	9229	48,800	154,500	3,260	28,100	-77,530	76,970
652.28	5.66	8.26	9493	52,200	206,700	4,150	34,300	-111,830	94,870
657.94	5.66	7.90	9499	53,600	260,300	4,370	39,200	-151,030	109,270
663.60	5.66	7.54	8825	53,700	314,000	5,740	43,500	-194,530	119,470
669.70	6.10	7.16	6816	53,800	367,800	7100	50,800	-245,330	122,470
676.01	6.31	6.76	2993	43,000	410,800	8380	56,100	-301,430	109,370
681.87	5.86	6.38	-2359	12,500	428,300	8630	55000	-356,430	71,470
687.83	5.96	6.00		-14050	414350	9660	58000	-414430	0

FIN BOX BENDING MOMENTS ARE COMPUTED FROM SHEAR FLOWS & FINGER LOADS SHOWN IN SKETCH ON PG. 6.17
A BENDING MOMENT DIAGRAM PLOTTED FROM LOADS IN COL. 10 IS ALSO INCLUDED ON PG. 6.17

FORM 1319A

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

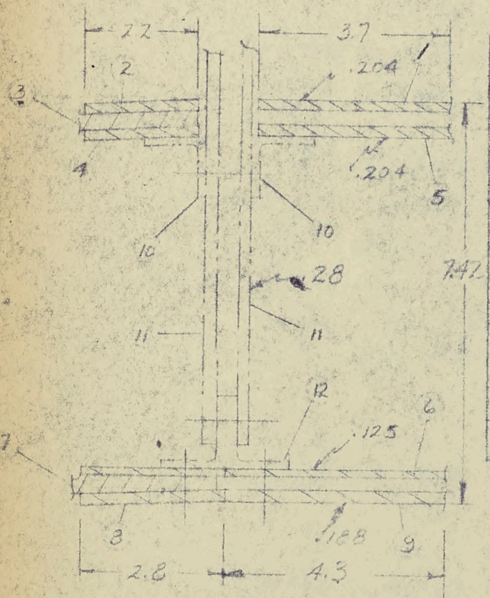
REPORT No.
SHEET No. 6.20

AIRCRAFT: C-105

PREPARED BY: McCABE | DATE: 10-13-55
CHECKED BY: | DATE:

AIR & INERTIA LOADS – FIN BOX STRUCTURE – STA 624 STA 687
SECTION PROPERTIES

STA. 669 (APPROX)



SEC. A-A

	A	Z	AZ	AZ²	I₀
1	.755	.102	.08		
2	.449	.212	.09		
3	.510	.439	.22	.1	
4	.449	.666	.30	.2	
5	.755	.556	.42	.2	
6	.887	6.920	6.13	42.4	
7	.750	7.060	5.29	37.3	
8	.526	7.406	3.90	28.9	
9	.809	7.326	5.92	43.3	
Σ	5.890	$\bar{Z}=3.79$	22.35	152.4	

$I = 152.4 - 3.79 \times 22.35$
$= 152.4 - 84.7$
$= 67.7$

ITEM	A	Z	AZ	AZ²	I₀
1-9	5.890		22.35	152.4	
10	.674	1.010	.68	.7	
11	3.30	3.610	12.28	44.3	9.6
12	.934	6.410	5.98	38.4	
Σ	10.798	$\bar{Z}=3.82$	41.28	235.8	9.6

$I = 235.8 + 9.6 - 3.82 \times 41.28$
$= 245.4 - 158.0 = 87.4$

FORM 1319A

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO.	6.21
		PREPARED BY	DATE
		MC CABE	10-14-55
		CHECKED BY	DATE

AIR & INERTIA LOADS ~ FIN BOX STRUCTURE - STA 624 - STA 687
LOWER SURFACE ATTACHMENTS
OUTER PLATE TO WING SKIN

CRITICAL CASE 11·3·a
MAX. SHEAR = 15617 LBS. (PG. 6.14)

VQ/I SHEAR
AT STA 669.7, SEC. A-A,
I = 81.4

$$\left.\begin{array}{ll} ⑧ & .526\ (7.406-3.82) = 1.89 \\ ⑨ & .809\ (7.326-3.82) = 2.84 \\ & Q = 4.73 \end{array}\right\} \text{PG. 6.20}$$

SHEAR PER IN. = VQ/I

$$= \frac{15617 \times 4.73}{81.4} = 850\ \#/\text{IN.}$$

ATTACHMENT IS BY 2 ROWS 1/4" BOLTS @ 1.45" AVG.
LOAD PER BOLT = $\frac{850 \times 1.45}{2} = 616\ \#$

IN ADDITION TO LOADS FROM FIN BOX BENDING, BOLTS ARE LOADED BY WING SKIN END LOADS.

WING SKIN END LOAD STA. 669 = 10,400 #/IN (PG. 3.04)
LOAD PER BOLT SHEAR FACE = $\frac{10400 \times 1.45}{2 \times 2}$
= 3,770 LBS.

RESULTANT LOAD = $(\overline{3770}^2 + \overline{616}^2)^{1/2}$
= 3,800 LBS.

ALLOW. LOAD 1/4" IN .188 = 4650 LBS.

M.S. = $\frac{4650}{3,800} - 1$ .22 M.S.

FORM 1319 A

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

REPORT No.	
SHEET No.	6.22
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	10-14-55
CHECKED BY	
DATE	

AIR & INERTIA LOADS ~ FIN BOX STRUCTURE - STN. 624 - STN. 667
LOWER SURFACE ATTACHMENTS
INNER PLATE TO WING SKIN

CRITICAL CASE 11·3·a
MAX. SHEAR = 15617 LBS (PG. 6.14)

VQ/I SHEAR
AT STA. 669.7, SEC. AA,

$$\left.\begin{array}{lll} I = 87.4 & & \\ 7 & .750(7.06 - 3.82) = & 1.89 \\ 8 & .824(7.406 - 3.82) = & 2.84 \\ 9 & .909(7.362 - 3.82) = & \underline{2.86} \\ & Q = & 7.59 \end{array}\right\} \text{PG. 6.21}$$

SHEAR PER IN. = VQ/I

$$= \frac{15617 \times 7.59}{87.4} = 1360 \text{ LBS./IN.}$$

ATTACHMENT IS BY 2 ROWS 1/4" BOLTS @ 1.45" AVG.

$$\text{LOAD PER BOLT} = \frac{1362 \times 1.45}{2} = 990 \text{ LBS.}$$

LOAD ON BOLT FROM WING SKIN END LOAD
= 3770 LBS. (PG. 6.21)

$$\text{RESULTANT} = \left(\overline{3770}^2 + \overline{990}^2\right)^{1/2}$$
$$= 3900 \text{ LBS.}$$

ALLOW. LOAD 1/4" BOLT IN .125 = 4250 LBS.

$$M.S. = \frac{4250}{3900} - 1 = \qquad \underline{.10 \text{ M.S.}}$$

FORM 1319A

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	6.23
		PREPARED BY	DATE
		McCABE	10-14-55
		CHECKED BY	DATE

AIR & INERTIA LOADS – FIN BOX STRUCTURE – STA 624 – STA 687
LOWER SURFACE ATTACHMENTS
EXTRUDED TEE TO INNER PLATE

CRITICAL CASE 11·3·4
MAX. SHEAR = 15617 LBS. (PG. 6.14)

VQ/I SHEAR
AT STA 662.7, SEC. A-A,
$I = 87.4$

6	.887 (6.92 − 3.82)	= 2.75	PG. 6.20
7	.750 (7.66 − 3.92)	= 1.83	
8	.526 (7.466 − 3.82)	= 2.84	
9	.809 (7.362 − 3.82)	= 2.86	
	Q	= 10.34	

SHEAR PER IN. = VQ/I

$$= \frac{15617 \times 10.34}{87.4} = 1850 \ \#/\text{IN.}$$

SINCE TEE IS DISCONTINUED AT EACH DIAPHRAGM ACTUAL LOAD ON TEE WILL BE HIGHER THAN LOAD COMPUTED ABOVE.

DIAPH. SPACING = 11.8
TEE LENGTH = 8.0

$$\text{ACTUAL LOAD ON TEE} = \frac{1850 \times 11.8}{8} = 2740 \ \#/\text{IN.}$$

ATTACHMENT IS BY 2-ROWS 1/4" BOLTS @ 1.1 IN.

$$\text{LOAD PER BOLT} = \frac{2740 \times 1.1}{2} = 1,510 \text{ LBS.}$$

ALLOW. LOAD 1/4" BOLT IN .125 = 4,280#

$$M.S. = \frac{4280}{1510} - 1 = \qquad \underline{\text{HIGH M.S.}}$$

FORM 1319A

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO.	6.24
		PREPARED BY	DATE
		McCABE	10-14-55
		CHECKED BY	DATE

AIR & INERTIA LOADS ~ FIN BOX STRUCTURE – STA 624 - STA 687
LOWER SURFACE ATTACHMENTS
EXTRUDED TEE TO FIN BOX SIDE PLATES

CRITICAL CASE 11·3·A
MAX. SHEAR = 15,617# (PG. 6.14)

VQ/I SHEAR
AT STA 665.7, SEC. A+A,
I = 87.4
6 .897 (6.92 − 3.82) = 2.75
7 .750 (7.06 − 3.82) = 2.43
8 .526 (7.406 − 3.82) = 2.84
9 .809 (7.362 − 3.82) = 2.86
12 .324 (6.410 − 3.82) = 2.42
Q = 13.30

PG. 6.20

SHEAR PER IN. = VQ/I

$$= \frac{15617 \times 13.30}{87.4} = 2380\ \#/\text{IN.}$$

SINCE TEE IS DISCONTINUED AT EACH DIAPHRAGM, ACTUAL LOAD ON TEE WILL BE HIGHER THAN LOAD COMPUTED ABOVE.
DIAPH. SPACING = 11.8 IN.
TEE LENGTH = 8.0 IN.

$$\text{ACTUAL LOAD PER IN.} = \frac{11.8 \times 2380}{8} = 3500\ \#/\text{IN.}$$

IN ADDITION TO LOADS FROM FIN BOX BENDING, ATTACHMENTS ARE LOADED BY VERTICAL COMPONENT OF WING SKIN KINK LOAD.

WING SKIN VERT. COMPONENT DUE TO KINK LOAD = 1200 #/IN. (PG. 4.10)

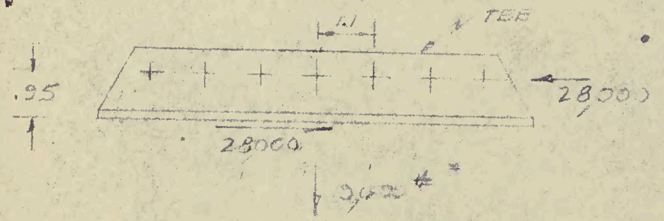
FORM 1319A

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

AIRCRAFT:		REPORT No.	
C-105		SHEET No.	6.25
		PREPARED BY	DATE
		McCABE	10-17-55
		CHECKED BY	DATE

AIR & INERTIA LOADS - FIN BOX STRUCTURE - STA 624 - STA 657
LOWER SURFACE ATTACHMENTS
EXTRUDED TEE TO FIN BOX SIDE PLATES

LOAD ON TEE FROM BENDING = 8 x 3,500 = 28,000# (PG. 6.24)
LOAD ON TEE FROM LINK LOAD = 8 x 1,200 = 9600# (PG. 6.24)



MOMENT ON ATTACHMENTS = 28,000 x .95 = 26,600 IN. LBS.
$I_P = 33.8$

LOAD ON CRIT. BOLT FROM MOMENT

$$= \frac{26600 \times 3.3}{33.8} = 2,600 \text{ LBS.}$$

LOAD PER BOLT FROM SHEAR
VERT. COMPONENT = 9,600/7 = 1370#
HORIZ. COMPONENT = 28,000/7 = 4,000#

$$\text{RESULTANT} = \left[\overline{4,000}^2 + (2600 + 1370)^2\right]^{1/2}$$
$$= 5,650 \text{ LBS.}$$

ALLOW. LOAD = 9,300 LBS.

$$M.S = \frac{9300}{5650} - 1 = \qquad \underline{.65\ M.S.}$$

FORM 1319A

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

AIRCRAFT: C-105	REPORT No.	SHEET No. 6.26
	PREPARED BY: McCABE	DATE: 10-17-55
	CHECKED BY	DATE

AIR & INERTIA LOADS — FIN BOX STRUCTURE — STA. 624 - STA. 687
UPPER SURFACE ATTACHMENTS
EXTRUDED ANGLES TO FIN BOX SIDE PLATES

CRITICAL CASE 11·3·a
MAX. SHEAR = 15,617 LBS. PG. 6.14

VQ/I SHEAR
AT STA. 669.7, SEC. A-A,
$I = 87.4$

$$\left.\begin{array}{lll} 1 & .155\,(3.82 - .102) = & 2.81 \\ 2 & .449\,(3.82 - .212) = & 1.62 \\ 3 & .510\,(3.82 - .433) = & 1.73 \\ 4 & .449\,(3.82 - .666) = & 1.41 \\ 5 & .755\,(3.82 - .556) = & 2.46 \\ 10 & .674\,(3.82 - 1.010) = & 1.89 \end{array}\right\} \text{PG. } 6.20$$

$Q = 11.91$

SHEAR PER IN ON ATTACHMENTS: VQ/I

$$= \frac{15617 \times 11.91}{87.4} = 2130 \text{ \#/IN}$$

INNER ANGLE IS DISCONTINUED AT EACH DIAPHRAGM, CONSEQUENTLY, ACTUAL LOAD PER IN WILL BE HIGHER THAN LOAD COMPUTED ABOVE.

DIAPHRAGM SPACING = 11.8 IN.
ANGLE LENGTH = 8.0 IN.

ACTUAL LOAD PER IN. PER ANGLE $= \dfrac{11.8 \times 2130}{2 \times 8.0}$

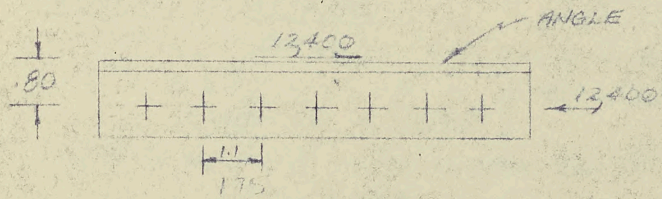
$= 1550$ #/IN.

FORM 1319A

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

AIRCRAFT:		REPORT NO.	
C-105		SHEET NO. 627	
		PREPARED BY	DATE
		McCABE	10-17-55
		CHECKED BY	DATE

AIR/INERTIA LOADS – FIN BOX STRUCTURE – STA. 624–STA. 687
UPPER SURFACE ATTACHMENTS
EXTRUDED ANGLES TO FIN BOX SIDE PLATES



TOTAL LOAD ON ANGLE = 8 × 1,550 = 12,400 LBS.
MOMENT ON ATTACHMENTS = 12400 × .80
= 9,900 IN. LBS.

$I_P = 33.8$

LOAD ON CRIT. BOLT FROM MOMENT

$= \dfrac{9{,}900 \times 3.3}{33.8} = 970$ LBS.

LOAD PER BOLT FROM SHEAR $= \dfrac{12400}{7} = 1{,}770$ LBS.

RESULTANT $= (\overline{1{,}770}^2 + \overline{970}^2)^{1/2}$
$= 2{,}010$ LBS.

ALLOW. LOAD $= 4{,}650$ LBS.

$M.S. = \dfrac{4650}{2010} - 1 =$ HIGH M.S.

FORM 1319A

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

REPORT NO.	
SHEET NO.	6.28
AIRCRAFT:	C-105
PREPARED BY	McCABE
DATE	10-18-55
CHECKED BY	
DATE	

AIR & INERTIA LOADS ~ FIN BOX STRUCTURE STA. 624 - STA. 697

UPPER JOGGLE ATTACHMENTS STA. 669

OUTER PLATE SPLICE TO DIAPHRAGM

CRITICAL CASE R.R2

MOMENT STA. 669 = 122,470 (PG. 6.17)

$I = 67.7$ } PG. 6.20

$c = 3.790 - .102 = 3.688$ }

STRESS IN PLATE FROM FIN BOX BENDING

$$= \frac{122470 \times 3.688}{67.7}$$

$= 6,670$ PSI.

PLATE AREA OVER DIAPH. WIDTH $= 2 \times .755$ (PG. 6.20)

$= 1.510$ IN.^{2}

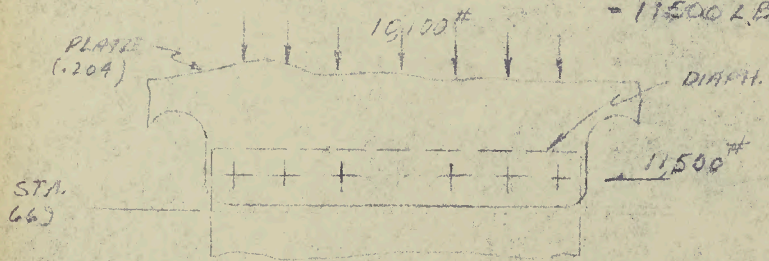
LOAD IN PLATE CARRIED BY DIAPH. ATTACHMENTS

$= 1.510 \times 6,670 = 10,100$ LBS.

IN ADDITION TO ABOVE LOAD, ATTACHMENTS ARE LOADED BY DIAPH. LOADS DUE TO FIN ROLL.

LOAD IN PLATE FROM DIAPH. $= 45,000/4$ (PG. 2.05)

$= 11,500$ LBS.



RESULT. LOAD PER ATTACHMENT $= \left[\left(\frac{10100}{6}\right)^2 + \left(\frac{11500}{6}\right)^2\right]^{1/2}$

$= 2,560$ LBS.

ALLOW. LOAD = 4650 LBS.

M.S. $\frac{4650}{2560} - 1.$ .82 M.S.

FORM 1219A

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

REPORT NO.
SHEET NO. 6.29

AIRCRAFT:		PREPARED BY	DATE
C-105		McCABE	10-19-55
		CHECKED BY	DATE

AIR & INERTIA LOADS — FIN BOX STRUCTURE — STA. 624-STA. 687
UPPER SURFACE ATTACHMENTS STA. 669
OUTER PLATE SPLICE TO WING SKIN

CRITICAL CASE 11.3.a

MOMENT STA. 669 = 151,600 IN. LBS. (PG. 6.14)

$$\left.\begin{array}{l} I = 61.7 \\ c = (3.79 - .212) = 3.518'' \end{array}\right\} 6.20$$

STRESS IN PLATE FROM FIN BOX BENDING

$$= \frac{151,000 \times 3.518}{61.7}$$

$$= 9,400 \text{ PSI.}$$

PLATE AREA AT ATTACHMENT TO WING SKIN

$= .449 \text{ IN.}^2$ (PG. 6.20)

LOAD IN PLATE = $9,400 \times .449 = 4,220$ LBS.

ASSUME LOAD IN PLATE IS TRANSFERRED TO WING SKIN THROUGH 4 - 1/4" ATTACHMENTS, THEN, LOAD PER ATTACHMENT

$= 4,220 / 4 = 1,050$ LBS.

IN ADDITION TO ABOVE LOAD, BOLTS ARE LOADED BY WING SKIN END LOAD.

WING SKIN END LOAD = 10,400 LBS/IN. (PG. 3.04)

PLATE ATTACHMENT TO WING SKIN IS BY 2-ROWS 1/4" BOLTS @ 1.42 IN. C.C. DBL. SHEAR,

LOAD PER BOLT = $\dfrac{10,400 \times 1.42}{2} = 7,400$ LBS.

LOAD PER SHEAR FACE = $7,400 / 2 = 3,700$ LBS.

RESULTANT LOAD = $(3,700^2 + 1,050^2)^{1/2}$

$= 3,850\#$

ALLOWABLE LOAD = $4,650\#$

$$M.S. = \frac{4,650}{3,850} - 1 = \quad \underline{.21 \ M.S.}$$

FORM 1319A