AVRO AIRCRAFT

TECHNICAL REPORT

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

ANALYZED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C 105.

REPORT No: 7-0558-45

FILE No:

No. OF SHEETS: 87

TITLE: ~~CONFIDENTIAL~~

Classification cancelled / Changed to UNCLASS
By authority of AVRS
Date 30 Sept 86
Signature
Unit / Rank / Appointment AVRS 5

PRELIMINARY INVESTIGATION

REAR FUSELAGE.

PREPARED BY N Pitchfield DATE Nov 15 1945

CHECKED BY DATE

SUPERVISED BY DATE Nov 15

APPROVED BY DATE

ISSUE NO.	REVISION NO.	REVISED BY	APPROVED BY	DATE	REMARKS
1	—	—	—	—	OTHER SECTIONS TO BE ADDED LATER.
2	57	C.D D SHONE.		15 NOV 45	SECTIONS 2 + 3 ADDED.
					15867379

FORM 1316A

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

REPORT NO. 7/0553/45
SHEET NO. 0-1

AIRCRAFT:		PREPARED BY	DATE
C 105	REAR FUSELAGE	C. DITCHFIELD	25 NOV 55
		CHECKED BY	DATE

GENERAL ANALYSIS.

INDEX

CONFIDENTIAL

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

REPORT No. 7/0558/45
SHEET No. 1-12

AIRCRAFT:		PREPARED BY	DATE
C 105	CENTRE FUSELAGE	C DITCHFIELD	1 NOV 45
		CHECKED BY	DATE

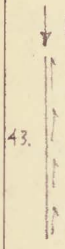
MEMBER 10

SAME AS MEMBER 8

$$\frac{\delta U}{\delta P} = 10^{-8}\left[35.699P - 2.094M\right]$$

MEMBER 11

$A = A_1$



$$\frac{\delta U}{\delta P} = \frac{P \cdot 43}{3 \cdot A_1 \cdot 10^7}$$

$$= 10^{-8}\left[\frac{430}{3A_1}P\right]$$

MEMBER 12

SAME AS MEMBER 11 EXCEPT $A = A_2$

$$\frac{\delta U}{\delta P} = 10^{-8}\left[\frac{430}{3A_2}P\right]$$

MEMBER 13

AS 12

$$\frac{\delta U}{\delta P} = 10^{-8}\left[\frac{430}{3A_2}P\right]$$

MEMBER 14

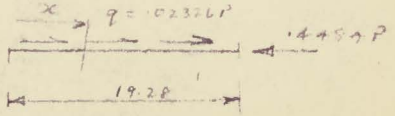
AS 10

$$\frac{\delta U}{\delta P} = 10^{-8}\left[\frac{430}{3A_1}P\right]$$

MEMBER 15

$$P_x = .02326\,P x$$

$$\frac{\delta P_x}{\delta P} = .02326\,x$$



$$\frac{\delta U}{\delta P} = \int_0^{19.28} \frac{.02326^2 P x^2\,dx}{2.5 \times 10^7}$$

$A = 2.5 \text{ ins.}^2$

FORM 1318A

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

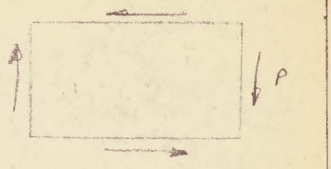
REPORT No. 7/0555/45
SHEET No. 1-14

AIRCRAFT:		PREPARED BY	DATE
C.105	CENTRE FUSELAGE	C. DITCHFIELD	1 NOV 55
		CHECKED BY	DATE

PANEL A.

$$\frac{\partial V}{\partial P} = \frac{P \cdot 19.28}{1.4 \times 4 \times 10^6}$$

$$= 10^{-8}\left[344.285P\right]$$



$A_w = 14 \times 1 = 1.4 \text{ in}^2$

PANEL B. $\frac{\partial V}{\partial P} = 0$

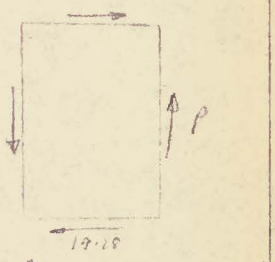
PANEL C. AS PANEL A

$$\frac{\partial V}{\partial P} = 10^{-8}\left[344.285P\right]$$

PANEL D

$$\frac{\partial V}{\partial P} = \frac{P \cdot 19.28}{2.15 \times 4 \times 10^6}$$

$$= 10^{-8}\left[224.186P\right]$$



$A_w = 43 \times .05 = 2.15 \text{ in}^2$

PANEL E.

$$\frac{\partial V}{\partial P} = 0$$

PANEL F. AS PANEL D.

$$\frac{\partial V}{\partial P} = 10^{-8}\left[224.186P\right]$$

FORM 1318A

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

REPORT NO. 7-0558-45/2
SHEET NO. 2-1

AIRCRAFT:		PREPARED BY	DATE
C 105	STA 591·65	D Shum	14 12 55
		CHECKED BY	DATE

Purpose:

The following analysis is to calculate the stiffness of the wing structure under a vertical load applied to it by the former

---

The initial calculations had assumed that the former was mounted directly onto a spar which was normal to A/c ℄

Subsequent calculations assumed a certain displacement at the pin connexion between the former and the wing structure

The present analysis will enable an effective I of the swept back wing structure to be calculated which may be compared with that used in the initial calculations. It also gives a value for the displacement

FORM 1319A

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

REPORT No. 7-0558-45/2
SHEET No. 2-3

AIRCRAFT:		PREPARED BY	DATE
C 105	STA 591.65	[signature]	14/12/55
		CHECKED BY	DATE

Assumptions:

The wing (between the centre fwd and the centre rear spars) is assumed to be of uniform chord = 52.8"
(chord @ ℄ = 621.68 − 568.78 = 52.90
" " B.L. 57.14 644.43 − 591.65 = 52.78)

Similarly these two spars are assumed to be of the same, and of uniform, depth = 11.0"

The wing has an anhedral of 4°, however this is neglected when applying the loads to the wing structure; these are assumed to act normally to a plane through the wing axis.

Both ribs are assumed to be parallel to A/c ℄.

The horizontal load at rib B.L. 8.0, and the moment that it applies at N.A. of spars, are considered negligible.

FORM 1319A

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

REPORT NO. 7-0558-45/2
SHEET NO. 2-4

AIRCRAFT:		PREPARED BY	DATE
C 105	STA. 591.65	D. J. Hyne	14/12/55
		CHECKED BY	DATE

Values Assumed:

Centre Fwd Spar: $I = 600\ in^4$
$t = 0.1$ in.

Centre Rear Spar: $I = 400\ in^4$
$t = 0.1$ in.

Rib @ B.L 8.0: $I = 200\ in^4$
$t = 0.1$ in

Rib @ BL. 57.1 $t = 0.15$ in

Top Skin $t = 0.115$ in

Bottom Skin $t = 0.14$ in

Young's Modulus $= 10.5 \times 10^6\ lbs/in^2$

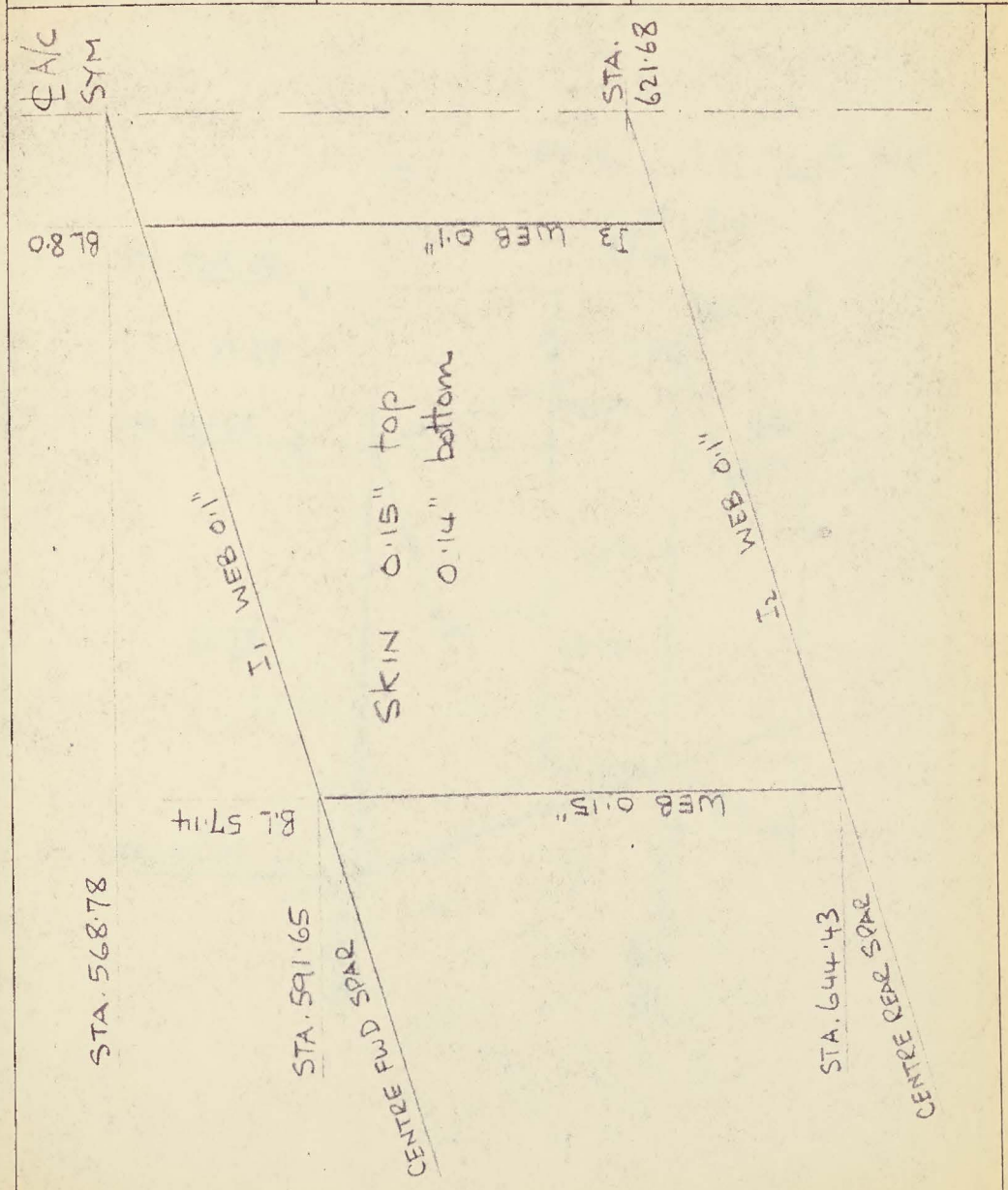
Shear " $= 4 \times 10^6\ lbs/in^2$

FORM 1319A

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

REPORT NO. 7-0558-45/2
SHEET NO. 2-6

AIRCRAFT:		PREPARED BY	DATE
C 105	STA 591.65		14 12 55
		CHECKED BY	DATE

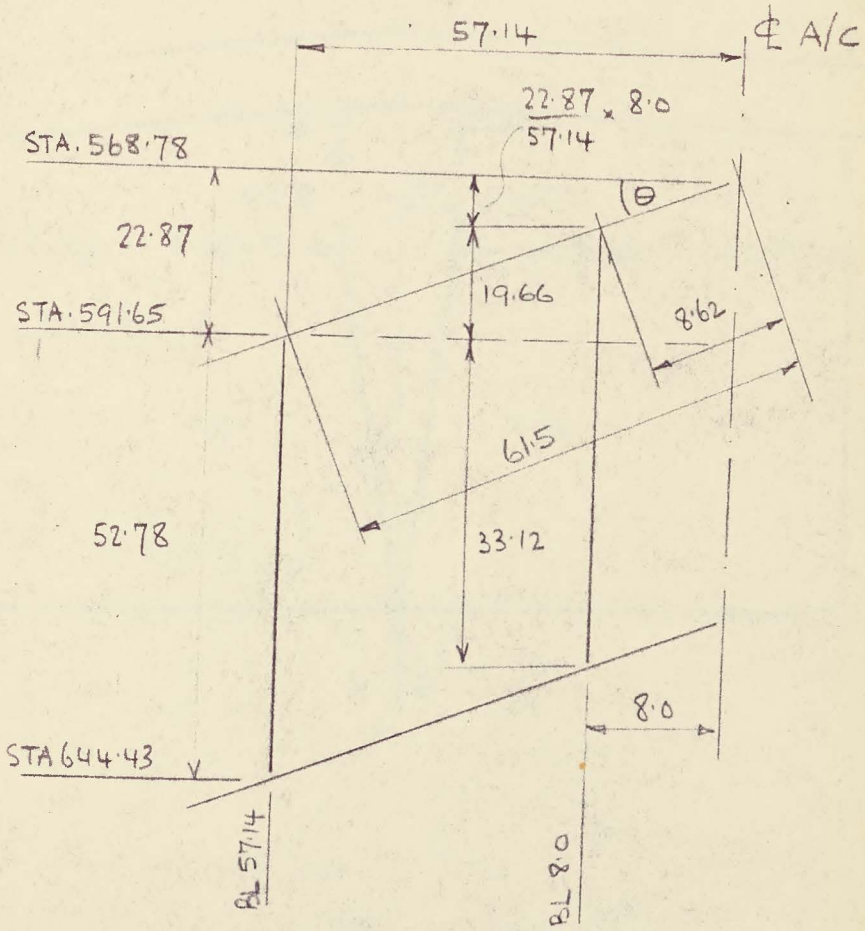


FORM 1319A

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

REPORT No. 7-0558-45/2
SHEET No. 2-7

AIRCRAFT:		PREPARED BY	DATE
C 105	STA. 591·65		14/12/55
		CHECKED BY	DATE

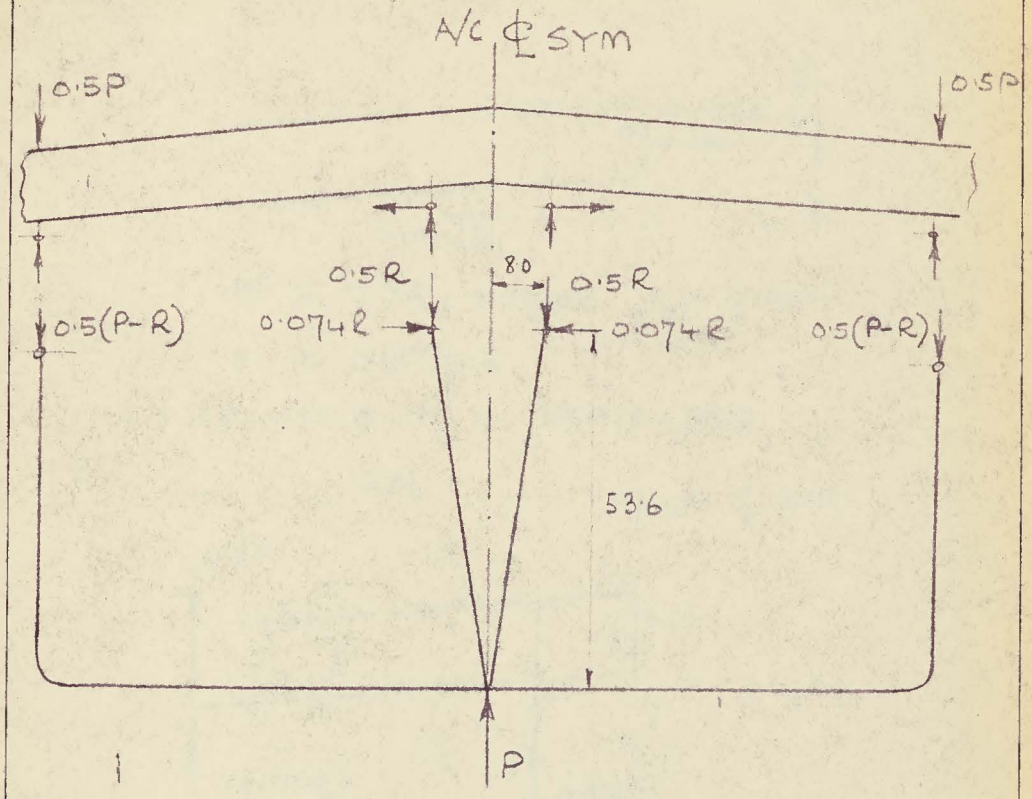


FORM 1319A

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

REPORT No. 7-0558-45/2
SHEET No. 2-8

AIRCRAFT:		PREPARED BY	DATE
C 105	STA 591.65	DJ Shaw	12/12/55
		CHECKED BY	DATE

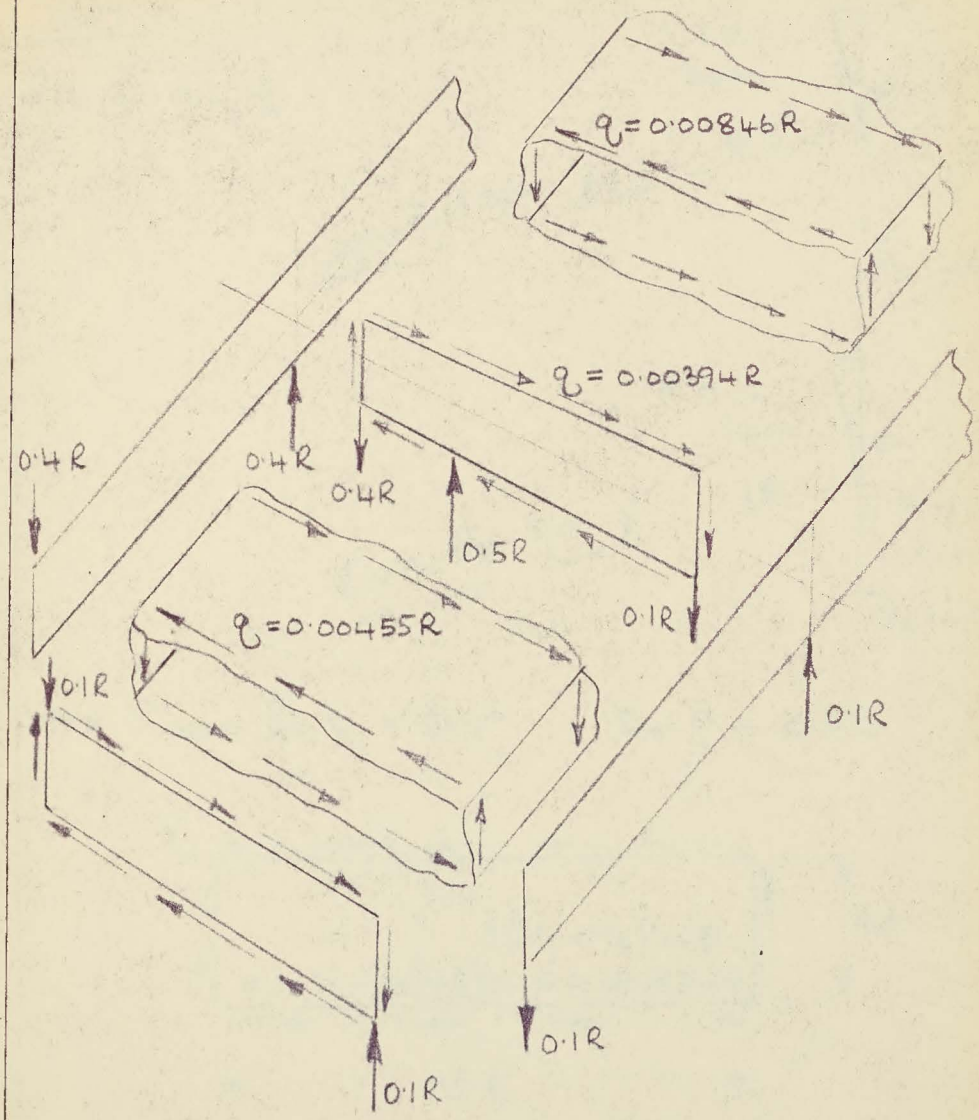


FORM 1318A

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

REPORT No. 7-0558-45 2
SHEET No. 2-14

AIRCRAFT:		PREPARED BY	DATE
C 105	STA 591·65		12 12 55
		CHECKED BY	DATE

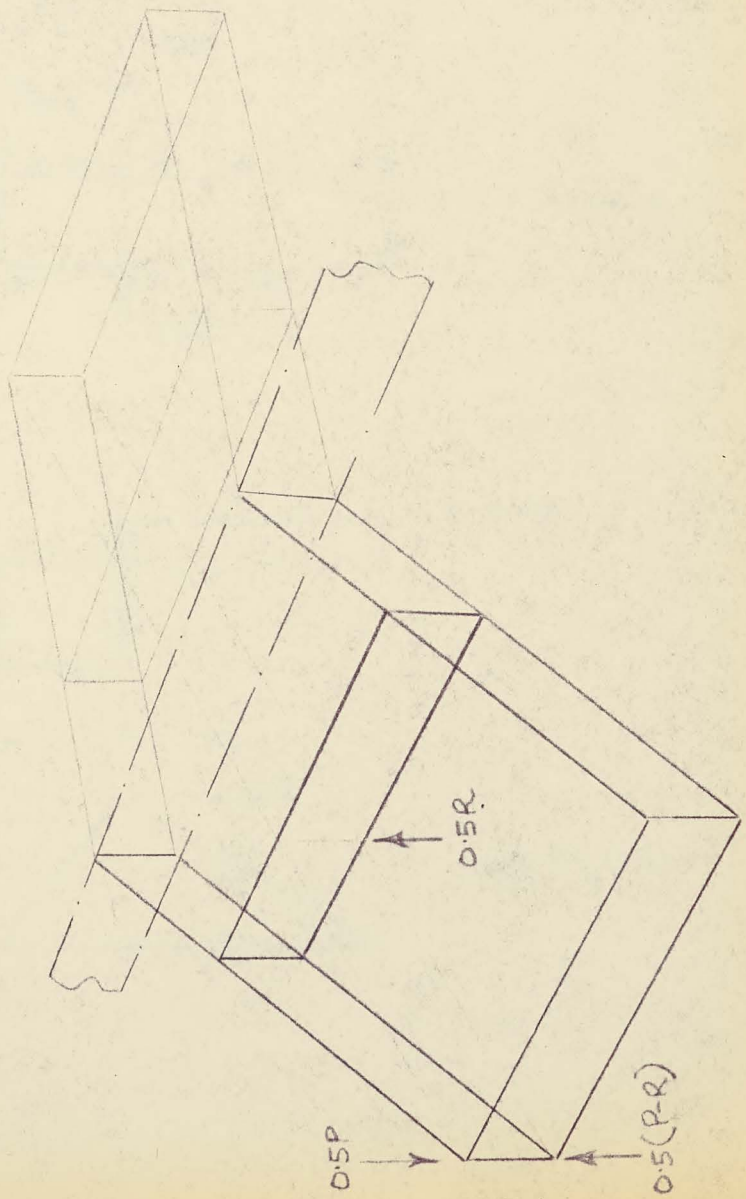


FORM 1319A

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

REPORT No. 7-0558-45 | 2
SHEET No. 2-16

AIRCRAFT:		PREPARED BY	DATE
C 105	STA 591·65	[signature]	12 | 12 | 55
		CHECKED BY	DATE



VERT

FORM 1319A

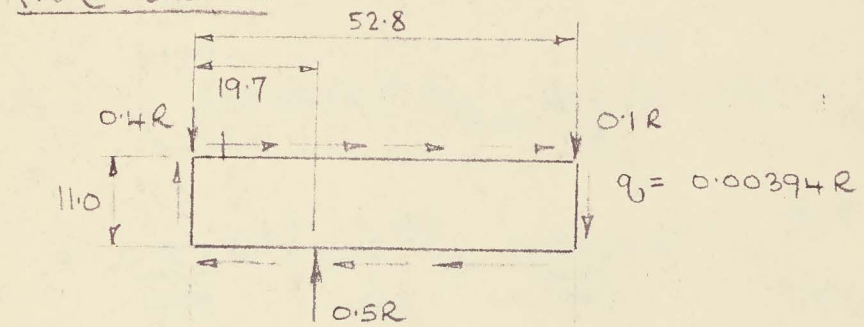
A. V. ROE CANADA LIMITED
MALTON - ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

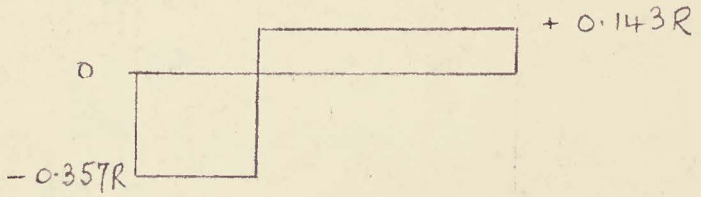
REPORT NO. 7-0558-45 | 2
SHEET NO. 2-17

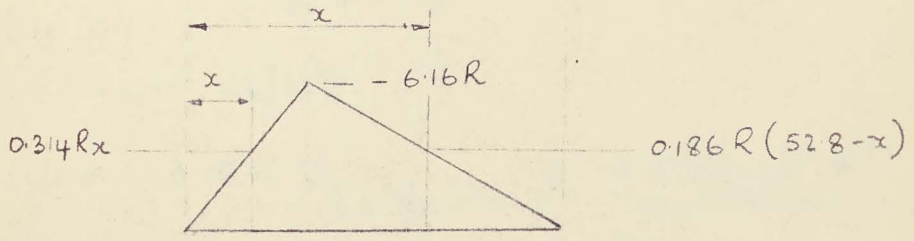
AIRCRAFT:		PREPARED BY	DATE
C 105	STA. 591.65		12 | 12 | 55
		CHECKED BY	DATE

VERT:

Rit @ B.L. 8.0







VERT:

Rdr @ B.L 80

$$U_S = \int_0^{19.7} (-0.357R)^2 \, dx/2AG + \int_{19.7}^{52.8} (0.143R)^2 \, dx/2AG$$

$$= \frac{0.127R^2}{2AG}\left[x\right]_0^{19.7} + \frac{0.0205R^2}{2AG}\left[x\right]_{19.7}^{52.8}$$

$$= \frac{R^2}{2AG}\left\{0.127 \times 19.7 + 0.0205 \times 33.1\right\}$$

$$= \frac{3.18R^2}{2AG}$$

$h = 11.0$
$t = 0.1$
$\therefore A = 1.1 \text{ in}^2$

$G = 4 \times 10^6 \text{ lb/in}^2$

$$\therefore U_S = 3.18R^2/2 \times 1.1 \times 4 \times 10^6 = \underline{0.362 \times 10^{-6} R^2}$$

$$U_B = \int_0^{19.7} (0.314Rx)^2 \, dx/2EI + \int_{19.7}^{52.8} \left\{0.186R(52.8-x)\right\}^2 dx/2EI$$

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

REPORT No. 7-0558-45/2
SHEET No. 2-19

AIRCRAFT:		PREPARED BY	DATE
C 105	STA. 591·65		12/12/55
		CHECKED BY	DATE

VERT

Rib @ B.L. 8·0

$$U_B = \frac{0{\cdot}0985 R^2}{2EI}\left[\frac{x^3}{3}\right]_0^{19{\cdot}7} + \frac{0{\cdot}0345 R^2}{2EI}\left[2790x - \frac{105{\cdot}6x^2}{2} + \frac{x^3}{3}\right]_{19{\cdot}7}^{52{\cdot}8}$$

$$= \frac{R^2}{2EI}\left\{0{\cdot}0985 \times \frac{7700}{3} + 0{\cdot}0345\left(2790 \times 33{\cdot}1 - 52{\cdot}8 \times 2402 + \frac{140,300}{3}\right)\right\}$$

$$= \frac{R^2}{2EI}\left\{253 + 0{\cdot}0345\left(92,300 - 127,800 + 46,800\right)\right\}$$

$$= \frac{R^2}{2EI}\left\{253 + 0{\cdot}0345 \times 11,300\right\}$$

$$U_B = \frac{R^2}{2EI} \times 643$$

$I = I_3$ int $E = 10{\cdot}5 \times 10^6$ lb/in²

$$U_B = R^2 \times 643 / 2 \times 10{\cdot}5 \times 10^6 \times I_3 = 30{\cdot}6 \times 10^{-6} R^2 / I_3$$

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

REPORT No. 7-0558-45|2
SHEET No. 2-21

AIRCRAFT:		PREPARED BY	DATE
C 105	STA 591·65	DS Thom	12|12|55
		CHECKED BY	DATE

VERT

Rib @ B.L 57·1

web $t = 0.15$, $h = 11.0$ $\Big\}$ $\therefore A = 1.65 \text{ in}^2$

$G = 4 \times 10^6 \text{ lb/in}^2$

$$U_S = 0.066\, R^2 / 1.65 \times 4 \times 10^6$$

$$U_S = 0.01 \times 10^{-6} R^2$$

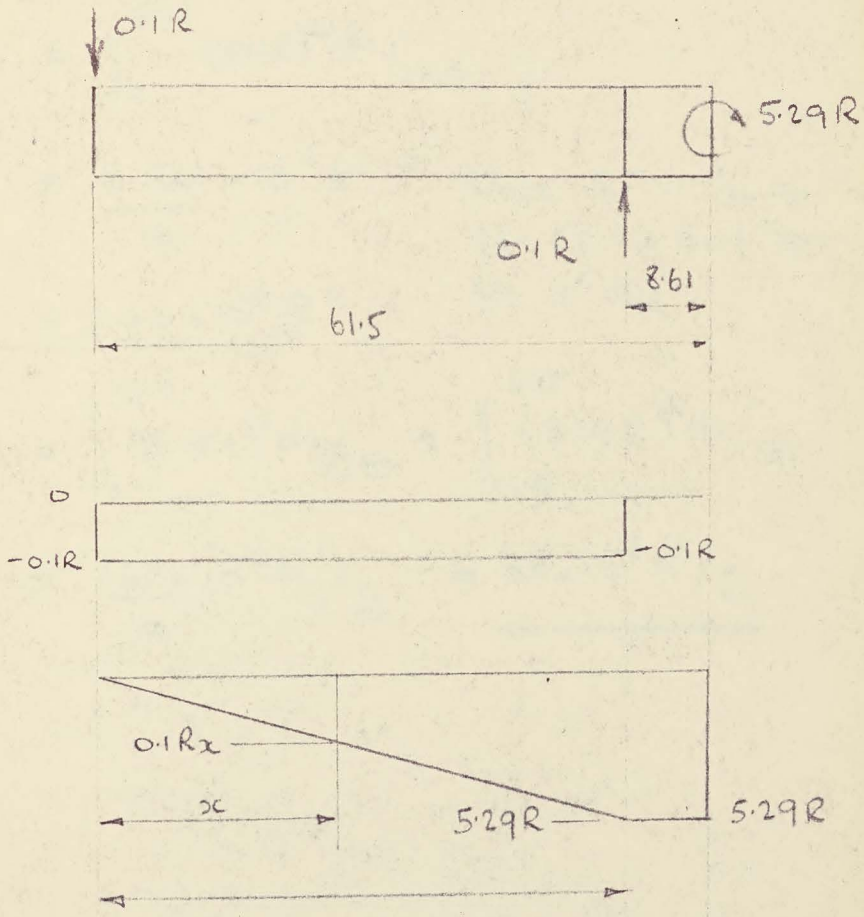
A. V. ROE CANADA LIMITED
MALTON · ONTARIO
TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0558-45/2
SHEET No. 2-25

AIRCRAFT		PREPARED BY	DATE
C 105	STA 591·65	J Shorne	12 | 12 | 55
		CHECKED BY	DATE

VERT

Centre Rear Spar



FORM 1318A

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

REPORT No. 7-0558-45/2
SHEET No 2-26

AIRCRAFT:		PREPARED BY	DATE
C 105	STA 591.65		12/12/55
		CHECKED BY	DATE

VERT

Centre Rear Span

$$U_S = \int_0^{52.9} (0.1R)^2 dx / 2AG$$

$$= \frac{0.961}{16} \times 10^{-6} R^2$$

Since S.F is 1/4 of that for Centre Fwd Span Us is 1/16

$$U_S = 0.06 \times 10^{-6} R^2$$

$$U_B = \int_0^{52.9} (0.1Rx)^2 dx / 2EJ + \int_{52.9}^{61.5} (5.29R)^2 dx / 2EJ$$

$$U_B = \frac{561}{16} \times 10^{-6} R^2 / I_2 = 35 \times 10^{-6} R^2 / I_2$$

FORM 1219A

VERT

Top Skin:

$$U_S = \int_0^{49.1} (0.00455R)^2 h\, dx/2tG + \int_{49.1}^{57.1} (0.00846R)^2 h\, dx/2tG$$

$$= \frac{20.7\times10^{-6} R^2 h}{2tG} \left[x\right]_0^{49.1} + \frac{71.6\times10^{-6} R^2 h}{2tG} \left[x\right]_{49.1}^{57.1}$$

$$= \frac{R^2 h\times10^{-6}}{2tG}\left(1015 + 573\right) = 794\, R^2 h\times10^{-6}/tG$$

$h = 52.8$ in

$t = 0.15$ in

$G = 4\times10^6$ lb/in^2

$$U_S = 794\, R^2\times 52.8\times10^{-6}/0.15\times 4\times10^6$$

$$U_S = 0.0699\times10^{-6} R^2$$

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

REPORT No. 7-0558-45 2
SHEET No 2-29

AIRCRAFT:		PREPARED BY	DATE
C·105	STA. 591·65	CHECKED BY	DATE

VERT

Item	U_S	U_B
Rib @ BL 80	$0.362\times10^{-6}R^2$	$30.6\times10^{-6}R^2/I_3$
" " 57·1	$0.01\times10^{-6}R^2$	
Centre Fwd Span	$0.96\times10^{-6}R^2$	$561\times10^{-6}R^2/I_1$
" Rear "	$0.06\times10^{-6}R^2$	$35\times10^{-6}R^2/I_2$
Top Skin	$0.0699\times10^{-6}R^2$	
Bottom "	$0.0748\times10^{-6}R^2$	

$\Sigma U_S = 1.54\times10^{-6}R^2$

If $I_1 = 600$ in^4 $561\times10^{-6}R^2/600 = 0.935\times10^{-6}R^2$

I_2 400 $35\times10^{-6}R^2/400 = 0.0875\times10^{-6}R^2$

I_3 200 $30.6\times10^{-6}R^2/200 = 0.153\times10^{-6}R^2$

$1.1755\times10^{-6}R^2$

$U = 2.72\times10^{-6}R^2$ FOR HALF STRUCTURE

$U = 5.44\times10^{-6}R^2$ " WHOLE "

$\frac{dU}{dR} = 10.88\times10^{-6}R$

ORM 1304A

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

REPORT No. 7/0558/45-2
SHEET No. 3-0

AIRCRAFT:		PREPARED BY	DATE
C.105.		C. DITCHFIELD	19 DEC 55
		CHECKED BY	DATE

SECTION 3

PREDICTION OF FATIGUE LIFE OF A COMPLETE BAY LENGTH OF WING TO FUSELAGE HINGE.

FORM 1316A

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

REPORT NO. 7/0558/45-2.
SHEET NO. 3-1.

AIRCRAFT:		PREPARED BY	DATE
C 105.	WING TO FUSELAGE JOINT.	C DITCHFIELD	8 DEC 55
		CHECKED BY	DATE

THE PROBLEM IS TO PREDICT THE FATIGUE LIFE FOR THE TOTAL WING TO FUSELAGE JOINT

VARIOUS ASSUMPTIONS WILL BE MADE AND LISTED BUT THE MAIN ONE IS THAT ONLY ONE LUG ON EACH HINGE SECTION IS IN CONTACT WITH ITS EQUIVALENT ON THE WING HINGE AND THAT ALL OTHER LUGS ARE THE MAX TOLERANCE APART. THIS ASSUMPTION IS MADE AS THE LIGHT ALLOY HINGE TEST SHEWED THAT ALTHOUGH THE GAPS WERE A VARYING SIZE THE ASSUMPTION STATED ABOVE GAVE THE CRITICAL RESULTS WHICH CHECKED WITH TEST RESULTS.

FIRST EACH TYP OF HINGE SECTION WILL BE ANALYSED TO FIND THE STIFFNESS. THEN THE HINGE SECTIONS WITH THE LONGERON IN A BAY BENEATH, WILL BE ANALYSED TO FIND THE DISTRIBUTION OF SHEAR LOAD.

FORM 1319A

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

REPORT No. 7/0558/45-2
SHEET No. 3-4

AIRCRAFT:		PREPARED BY	DATE
C.105	WING TO FUSELAGE HINGE	C. DITCHFIELD	8 DEC 55
		CHECKED BY	DATE

END LOAD. ASSUME 1" BEARING WIDTH

$$f_b = \frac{P \cdot 5}{3 \times \cdot 1 \times \cdot 265 \times 29 \times 10^6}$$

$$= \cdot 217 P \times 10^{-6}$$

SHEAR

$$f_s = \frac{P \cdot 4}{\cdot 206 \times 11 \times 10^6}$$

$A_w = \cdot 5 \times \cdot 412$ (AV WIDTH)
$= \cdot 206$ INS^2.

$$= \cdot 177 P \times 10^{-6}$$

THUS

$$10^6 \times \cdot 002 = \cdot 171 P + \cdot 217 P + \cdot 177 P.$$

$$P = \frac{2000}{\cdot 565}$$

$$= 3540 \text{ LBS}$$

RM 1104

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

REPORT No. 7/0559/45-2
SHEET No. 3-5

AIRCRAFT:		PREPARED BY	DATE
C 105.	WING TO FUSELAGE HINGE.	C. DITCHFIELD	9 DEC 55.
		CHECKED BY	DATE

ASSUMING TWO ADJACENT BAYS WITH THE MAX. SHEAR FLOW OF 1200 LBS/IN. ALSO ASSUMING THAT THE SHEAR IS APPLIED UNIFORMLY FROM THE SHEET TO THE LONGERON. THUS THE BAY TO BE ANALYSED WILL EXTEND FROM THE CENTRE OF ONE A/C BAY TO CENTRE OF THE NEXT. THERE ARE FOUR ALUMINUM HINGES AND ONE STEEL HINGE

TO FIND THE BALANCING SHEARS ON EACH HINGE SECTION WE MUST USE COMPATABILITY OF DEFLECTION. THERE ARE THREE TYPES OF DEFLECTION LUG, BOLT SLIP AND END LOAD DEFLECTION IN LONGERON, WHICH WILL BE USED TO FIND THE MAXIMUM BALANCING SHEARS ON THE STEEL AT A LOW LOAD LEVEL.

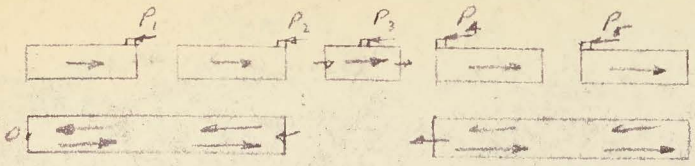
THE STEEL FITTING IS ATTACHED TO THE LONGERON BY MEANS OF TWO BOLTS AT EACH END.

DRM 1318A

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

REPORT NO. 7/0558/45-2
SHEET NO. 3-6.

AIRCRAFT:		PREPARED BY	DATE
C 105.	WING TO FUSELAGE HINGE.	C. DITCHFIELD	9 Dec 55
		CHECKED BY	DATE



FOR BAY LENGTH OF 53" STEEL HINGE 7" LONG

ALUMINIUM HINGE 11.5" LONG.

FOR 20/0 LOAD LEVEL AT 1200 LBS/IN ULTIMATE

SHEAR = 240 LBS/IN

SHEAR / AL. = $240 \times 11\frac{1}{2}$

= 2760 LBS.

SHEAR / ST. = 1680 LBS

ASSUME LUGS BEARING AS SHOWN ABOVE.

$2P_1 + 2P_2 + P_3 = 240 \times 53 = 12720$ LBS.

THE BASE TO WHICH THE HINGE SECTIONS ARE JOINED IS ASSUMED RIGID AND THE SHEAR LOAD IS ASSUMED UNIFORMLY DISTRIBUTED ON BOLT CONNECTIONS.

TAKE LONGERON L.H. END AS DATUM.

ALUMINIUM LUG DEFLECTS .001 FOR 766 LBS

STEEL " " " 1770 "

HINGE AREA = 0.3 INS^2 LONGERON AREA = 0.23 INS^2

$E_{ALUM} = 10.5 \times 10^6$, $E_{STEEL} = 29 \times 10^6$.

BOLT SLIP ASSUME .001 IN. FOR 6"25 LBS

FORM 1319A

ASSUMING P_1 & P_5 GREATER THAN 1532 LBS

LOAD ON END LUG $= 1532 + \frac{P_1 - 1532}{6}$

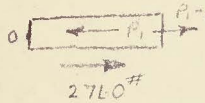
$= 1277 + \frac{P_1}{6}$

$\delta_{LUG} = \frac{1277 + .167 P_1}{766} \times .001$

$= (1667 + .218 P_1)\ 10^{-6}$

$\delta_{FL_{11}} = \frac{P_1 \cdot 11.5}{.3 \times 3 \times 10.5 \times 10^6}$

$= (1.217 P_1)\ 10^{-6}$



$\delta_{BOLT\ SLIP} = \frac{P_1}{10} \times \frac{.001}{.625}$ [10 BOLTS PER WING]

$= (.16 P_1)\ 10^{-6}$

$\delta_{FL_L} = -\frac{(P_1 - 2760)\ 11.5}{3. \cdot 23 \times 10.5 \times 10^6}$

$= (-1.588 P_1 + 4380)\ 10^{-6}$

DEFLECTION OF LUG ① RELATIVE TO O.

$= \begin{pmatrix} .218 P_1 + 1667 \\ 1.217 P_1 \\ -1.588 P_1 + 4380 \end{pmatrix} 10^{-6}$

$= (-.153 P_1 + 6047)\ 10^{-6}$

ORM 1319A

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

REPORT No. 7/0558/45-2
SHEET No. 3-10

AIRCRAFT:	WING TO FUSELAGE HINGE	PREPARED BY	DATE
C.105		C. DITCHFIELD	9 DEC 55
		CHECKED BY	DATE

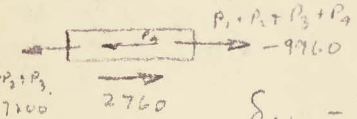
$$\delta_{LV4} = \frac{P_4}{766} \times 1.001$$

$$= 1.307 P_4 \times 10^{-6}$$

$$\delta_{EL_H} = - \frac{P_4 \cdot 11.5}{3 \times .3 \times 10.5 \times 10^6}$$

$$= -1.217 P_4 \times 10^{-6}$$

$$\delta_{BS} = \text{"} .16 P_4 \times 10^{-6} \qquad \text{see P. 3-7}$$



$$\delta_{EL_L} = \frac{-(P_1+P_2+P_3-7200)11.5}{.23 \times 10.5 \times 10^7} - \frac{(P_4-2760)11.5}{3 \times .23 \times 10.5 \times 10^6}$$

$$= (-4.764P_1 - 4.764P_1 - 4.764P_3 + 34300 - 1.558P_4 + 4380)\,10^{-6}$$

$$= (-4.764P_1 - 4.764P_2 - 4.764P_3 - 1.558P_4 + 38680)\,10^{-6}$$

DEFLECTION OF LVS A RELATIVE TO O

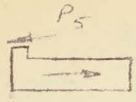
$$= 1.307P_4 - 1.217P_4 + .16P_4 - 4.764P_1 - 4.764P_2 - 4.764P_3$$
$$- 1.558P_4 + 38680 + .8P_1 + .8P_1 + .8P_3 - 5760 + .8P_1 + .8P_2$$
$$- 4420 - .403P_1 - .403P_2 - .134P_3 + 2451 - 4.764P_1$$
$$- 1.558P_1 + 17520 - 1.558P_1 + 4380)\,10^{-6}$$

$$= (-9.916P_1 - 5.155P_2 - 4.098P_3 - 1.338P_4 + 52851)\,10^{-6}$$

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

REPORT No. 7/0555/45-2
SHEET No. 3-11

AIRCRAFT:	WING TO FUSELAGE HINGE	PREPARED BY	DATE
C.105.		A DITCHFIELD	9 DEC 55.
		CHECKED BY	DATE

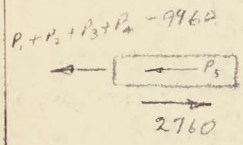


$$\delta_{WING} = \frac{1277 + .167 P_5}{765} \times .001 \qquad \text{SEE P.3-7}$$

$$= (1667 + .218 P_5) 10^{-6}$$

$$\delta_{FUS} = -1.217 P_5 \times 10^{-6}$$

$$\delta_{BC} = .16 P_5 \times 10^{-6}$$



$$P_5 = 12720 - P_1 - P_2 - P_3 - P_4.$$

$$\delta_{ELL} = \frac{(P_5 - 2760)111.5}{3.23 \times 10.5 \times 10^6}$$

$$= (1.588 P_5 - 4380) 10^{-6}$$

DEFLECTION OF WG 5 RELATIVE TO O.

$$= (1667 + .218 P_5 - 1.217 P_5 + .16 P_5 + 1.588 P_5 - 4380) 10^{-6} +$$

$$(-9.916 P_1 - 5.155 P_2 - 4.098 P_3 - 1.338 P_4 + 52851) 10^{-6}$$

$$- (1.307 P_4 - 1.217 P_4 + .16 P_4) 10^{-6}$$

$$= (-9.916 P_1 - 5.155 P_2 - 4.098 P_3 - 1.588 P_4 + 0.749 P_5 + 50138) 10^{-6}.$$

FORM 1319A

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

REPORT No. 7/0558/45 1552
SHEET No. 3-12

AIRCRAFT:		PREPARED BY	DATE
C.105	WING TO FUSELAGE HINGE	C. DITCHFIELD	9 DEC 55
		CHECKED BY	DATE

AS WE ASSUME THAT THE REACTIONS P_1 TO P_5 ARE PROVIDED BY AN INFINITE FOUNDATION THEN THE CALCULATED DEFLECTIONS MUST BE EQUAL.
THUS WE HAVE 5 EQUATIONS AND SIX UNKNOWNS. THE SIXTH EQUATION IS PROVIDED BY $P_5 = 12720 - P_1 - P_2 - P_3 - P_4$ — (6)

$10^6\delta = (6047 - .153P_1)$ (1)

$= (21900 - 6.352P_1 + .952P_2)$ (2)

$= (15705 - 5.753P_1 - .989P_2 + .498P_3)$ (3)

$= (52551 - 9.916P_1 - 5.155P_2 - 4.098P_3 - 1.338P_4)$ (4)

$= (50138 - 9.916P_1 - 5.155P_2 - 4.098P_3 - 1.588P_4 + 0.749P_5)$ (5)

SUBSTITUTING (6) IN (5)

$\delta.10^6 = 50138 - 9.916P_1 - 5.155P_2 - 4.098P_3 - 1.588P_4$
$\quad 9527 - 0.749P_1 - 0.749P_2 - 0.749P_3 - 0.749P_4$

$= 59665 - 10.665P_1 - 5.904P_2 - 4.847P_3 - 2.337P_4$ (7)

SUBST. (1) IN (2), (3), (4) & (7)

$15853 - 6.199P_1 + .957P_2 = 0$ (8)

$12658 - 5.600P_1 - .989P_2 + .498P_3 = 0$ (9)

$46804 - 9.763P_1 - 5.155P_2 - 4.098P_3 - 1.338P_4 = 0$ (10)

$53618 - 10.512P_1 - 5.904P_2 - 4.847P_3 - 2.337P_4 = 0$ (11)

FORM 1319A

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

REPORT No. 7/C555/45-2
SHEET No 3-13

AIRCRAFT:	WING TO FUSELAGE JOINT	PREPARED BY	DATE
C.105.		C. DITCHFIELD	9 DEC 55
		CHECKED BY	DATE

FROM (8) $P_1 = 2557 + .153 P_2$

SUBST. IN (9), (10) & (11).

$$12658 - .489 P_2 + .498 P_3$$
$$-14319 - .860 P_2$$
$$-1661 - 1.849 P_2 + .498 P_3 = 0. \quad (12)$$

$$46804 - 5.155 P_2 - 4.098 P_3 - 1.338 P_4$$
$$-24964 - 1.499 P_2$$
$$21840 - 6.654 P_2 - 4.098 P_3 - 1.338 P_4 = 0 \quad (13)$$

$$53618 - 5.904 P_2 - 4.847 P_3 - 1.337 P_4$$
$$-26879 - 1.614 P_2$$
$$26839 - 7.528 P_2 - 4.847 P_3 - 2.337 P_4 = 0 \quad (14)$$

FROM (12)

$$P_2 = -898 + .269 P_3$$

SUBST IN (13) & (14)

$$21840 - 4.098 P_3 - 1.338 P_4$$
$$+ 5975 - 1.790 P_3$$
$$27815 - 5.888 P_3 - 1.338 P_4 = 0. \quad (15)$$

$$26839 - 4.847 P_3 - 2.337 P_4$$
$$+ 6760 - 2.025 P_3$$
$$33599 - 6.872 P_3 - 2.337 P_4 = 0 \quad (16)$$

FROM (15)

$$P_3 = 4724 - .227 P_4$$

SUBST IN (16)

$$33599 - 2.337 P_4$$
$$- 32463 + 1.560 P_4$$
$$+ 1136 - 0.777 P_4 = 0$$
$$P_4 = 1462 \text{ LBS.}$$

FORM 1318A

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

REPORT NO. 7/0558/45.1112
SHEET NO. 3-15

AIRCRAFT:		PREPARED BY	DATE
C 105	WING TO FUSELAGE HINGE	C. DITCHFIELD	12 DEC 55.
		CHECKED BY.	DATE

PUTTING LUGS AT 4.75 AT R.H. ENDS OF HINGES.

FROM P3-10.

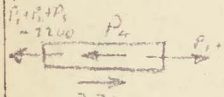
$$\delta_{LUG} = \frac{P_4}{766} \times .001$$

$$= 1.307\, P_4 \times 10^{-6}$$

$$\delta_{EL_H} = \frac{P_4 \cdot 11.5}{3 \times .3 \times 10.5 \times 10^6}$$

$$= 1.217\, P_4 \times 10^{-6}$$

$$\delta_{BS} = .16\, P_4 \times 10^{-6}$$



$$\delta_{EL_1} = \frac{-(P_1+P_2+P_3-7260)\,11.5}{.73 \times 10.5 \times 10^6} - \frac{(P_4-2760)\,11.5}{3 \times .23 \times 10.5 \times 10^6}$$

$$= (-4.764P_1 - 4.764P_2 - 4.764P_3 - 1.588P_4 + 38680)\,10^{-6}$$

DEFLECTION OF LUG 4 RELATIVE TO O

$$= (-9.916P_1 - 5.155P_2 - 4.098P_3 - 1.338P_4 + 52851)\,10^{-6}$$
$$+ 2.434P_4 \times 10^{-6}$$

$$= (-9.916P_1 - 5.155P_2 - 4.098P_3 + 1.096P_4 + 52851)\,10^{-6}$$

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

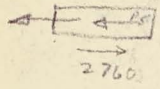
REPORT No. 7/0558/45-2
SHEET No. 3-16

AIRCRAFT:		PREPARED BY	DATE
C 105	WING TO FUSELAGE HINGE	C DITCHFIELD	12 DEC 58
		CHECKED BY	DATE

$$\delta_{LUG} = (1667 + .218\tfrac{P_5}{5})10^{-6}$$

$$\delta_{ELH} = 1.217\,P_5 \times 10^{-6}$$

$$\delta_{BS} = .16\,P_5 \times 10^{-6}$$



$$\delta_{EL_1} = (1.558\,P_5 - 4350)10^{-6}$$

DEFLECTION OF LUG 5 RELATIVE TO 0

$$= (-9.916P_1 - 5.155P_2 - 4.098P_3 - 1.558P_4 + .749P_5 + 50138)10^{-6}$$
$$+ 2.434P_5 \times 10^{-6}$$

$$= (-9.916P_1 - 5.155P_2 - 4.098P_3 - 1.558P_4 + 3.183P_5 + 50138)10^{-6}$$

FORM 1319A

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

REPORT No. 7/0558/45-2
SHEET No. 3-18

AIRCRAFT:	WING TO FUSELAGE HINGE	PREPARED BY	DATE
C.105		C DITCHFIELD	12 DEC 53
		CHECKED BY	DATE

SUBSTIT. (12) IN (9) (10) + (11)

$$12658 - .989P_2 + .498P_3$$
$$-14319 - .860P_2$$
$$-1661 - 1.849P_2 + .498P_3 = 0 \quad (13)$$

$$46804 - 5.155P_2 - 4.098P_3 + 1.096P_4$$
$$-24964 - 1.499P_2$$
$$21840 - 6.654P_2 - 4.098P_3 + 1.096P_4 = 0 \quad (14)$$

$$84579 - 8.338P_2 - 7.281P_3 - 4.771P_4$$
$$-33103 - 1.988P_2$$
$$41476 - 10.320P_2 - 7.281P_3 - 4.771P_4 = 0 \quad (15)$$

FROM (13)
$$1.849P_2 = -1661 + .498P_3$$
$$P_2 = -898 + .269P_3 \quad (16)$$

SUBSTIT (11) IN (14) + (15)
$$21840 - 4.098P_3 + 1.096P_4$$
$$+5975 - 1.790P_3$$
$$27815 - 5.888P_3 + 1.096P_4 = 0 \quad (17)$$

$$41476 - 7.281P_3 - 4.771P_4$$
$$+9267 - 2.776P_3$$
$$50743 - 10.057P_3 - 4.771P_4 = 0 \quad (18)$$

FROM (17)
$$5.888P_3 = 27815 + 1.096P_4$$
$$P_3 = 4724 + .186P_4 \quad (19)$$

SUBST (19) IN (18)
$$50743 - 4.771P_4$$
$$-47509 - 1.870P_4$$
$$3234 - 6.641P_4 = 0$$
$$P_4 = 487 \text{ LBS.}$$

$P_3 = 4815$ LBS. $P_1 = 2618$ LBS.
$P_2 = 397$ LBS. $P_5 = 4403$ LBS.

FORM 1310A

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

REPORT No. 7/0558/45-2
SHEET No. 3-19

AIRCRAFT:		PREPARED BY	DATE
C-105	WING TO FUSELAGE HINGE	C. DITCHFIELD	12 DEC 55
		CHECKED BY	DATE

IF LUG 4 IS CARRYING AT L.H. END & 5 AT R.H. END.
EQNS. ① ② ③ & ④ AS P.3-12. ⑤ AS P.3-17.
FROM P3-13 & 3-14 EQNS. 15 & 16 RESP.

$$27515 - 5.858\,P_3 - 1.338\,P_4 = 0 \quad ①$$

$$50743 - 10.057\,P_3 - 4.771\,P_4 = 0 \quad ②$$

FROM ① $P_3 = 4724 - .227\,P_4$

SUBSTIT. IN ②

$$50743 - 4771\,P_4$$
$$- 47509 + 2.233\,P_4$$
$$3234 - 2.488\,P_4 = 0$$

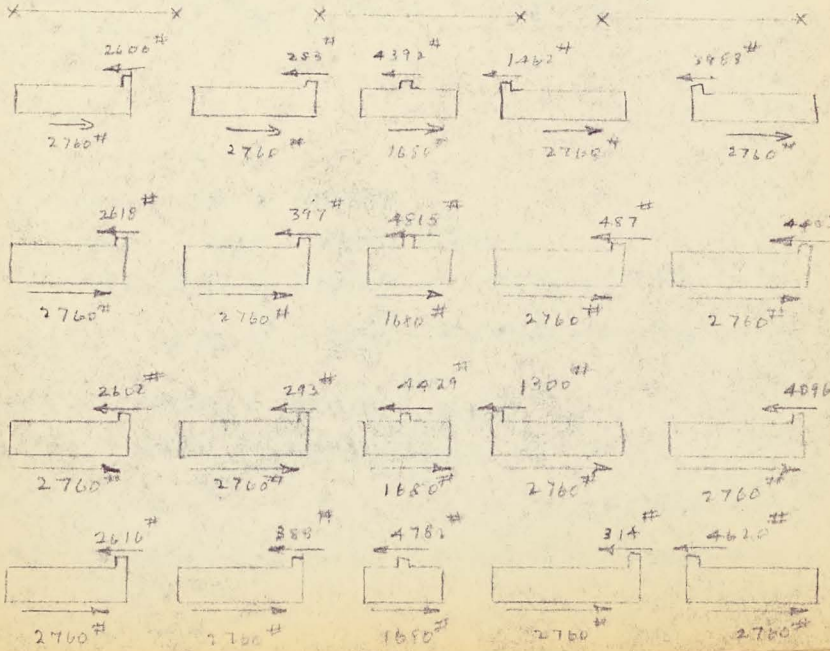
$P_4 = 1300$ LBS.

$P_3 = 4429$ LBS.

$P_2 = 293$ LBS.

$P_1 = 2602$ LBS.

$P_5 = 4096$ LBS



AS ALL P_3 LOADS ARE OVER 3540 LBS
ALL SOLUTIONS WILL HAVE TO BE RECALCULATED. SEE P.3-20-25.

FORM 1319A

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

REPORT No. 7/0558/45-2
SHEET No 3-21

AIRCRAFT:		PREPARED BY	DATE
C.105	WING TO FUSELAGE HINGE	C D ITCHFIELD	12 DEC 55
		CHECKED BY	DATE

FROM (1)

$$P_1 = 2557 + .153P_2$$

SUBST IN (2) (3) & (4).

$$14258 - .989P_2 + .046P_3$$
$$-14319 - .800P_2$$
$$-61 - 1.849P_2 + .046P_3 = 0 \quad (5)$$

$$21840 - 6.054P_2 - 4.098P_3 - 1.338P_4 = 0 \quad (6)$$

$$26839 - 7.528P_2 - 4.847P_3 - 2.337P_4 = 0. \quad (7)$$

SEE P. 10

FROM (5).

$$P_2 = -33 + .025P_3$$

SUBST. IN (6) & (7)

$$21840 - 4.098P_3 - 1.338P_4$$
$$+ 270 - .165P_3$$
$$22060 - 4.263P_3 - 1.338P_4 = 0. \quad (8)$$

$$26839 - 4.847P_3 - 2.337P_4$$
$$+ 248 - .187P_3$$
$$27087 - 5.034P_3 - 2.337P_4 = 0 \quad (9)$$

FROM (8)

$$P_3 = 5175 - .314P_4$$

SUBST IN (9).

$$27087 - 2.337P_4$$
$$26051 - 1.581P_4$$
$$1036 - 3.918P_4 = 0.$$
$$P_4 = 264 \text{ LBS}$$

$P_3 = 5092$ LBS. $P_2 = 94$ LBS. $P_1 = 2571$ LBS.

$P_5 = 4699$ LBS.

FORM 1319A

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

REPORT No. 7/0558/45-2
SHEET No. 3-24

AIRCRAFT:		PREPARED BY	DATE
C 105.	WING TO FUSELAGE HINGE.	C DITCHFIELD	12 DEC 55
		CHECKED BY	DATE

FROM (5).

$$P_2 = -33 + .025 P_3$$

SUBST IN (6) + (7).

$$21810 - 4.048 P_3 - 1.335 P_4$$
$$220 - .165 P_3$$
$$21060 - 4.213 P_3 - 1.335 P_4 = 0$$

$$41476 - 7.281 P_3 - 4.771 P_4$$
$$341 - .252 P_3$$
$$41817 - 7.533 P_3 - 4.771 P_4 = 0 \quad (9)$$

FROM (8) $P_3 = 5175 - .314 P_4$

SUBST. IN (9)

$$41817 - 4.771 P_4$$
$$-39014 + 2.367 P_4$$
$$2803 - 2.404 P_4 = 0$$

$$P_4 = 1166 \text{ LBS}$$

$P_3 =$ 4809 LBS. $P_2 =$ 87 LBS. $P_1 =$ 2570 LBS.

$P_5 =$ 4088 LBS.

FOR LUG 4 AT R.H. END & LUG 5 AT L.H. END

$10^6 S = 6047 - .153 P_1$

$= 21400 - 6.352 P_1 + .952 P_2$ P3-2b

$= 20305 - 5.753 P_1 - .989 P_2 + .046 P_3$

$= 52851 - 9.916 P_1 - 5.155 P_2 - 4.098 P_3 + 1.096 P_4$

$= 59665 - 10.665 P_1 - 5.904 P_2 - 4.847 P_3 - 2.337 P_4$

FORM 1319A

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

REPORT No. 7/0558/45-2
SHEET No. 3-25

AIRCRAFT:		PREPARED BY	DATE
C-105	WING TO FUSELAGE HINGE	G. DITCHFIELD	12 DEC 55
		CHECKED BY	DATE

THESE EQUATIONS REDUCE TO:—

$$72060 - 4.263P_3 + 1.096P_4 = 0 \quad (1)$$
$$27687 - 5.034P_3 - 2.337P_4 = 0 \quad (2)$$

} P3-21

FROM (1)

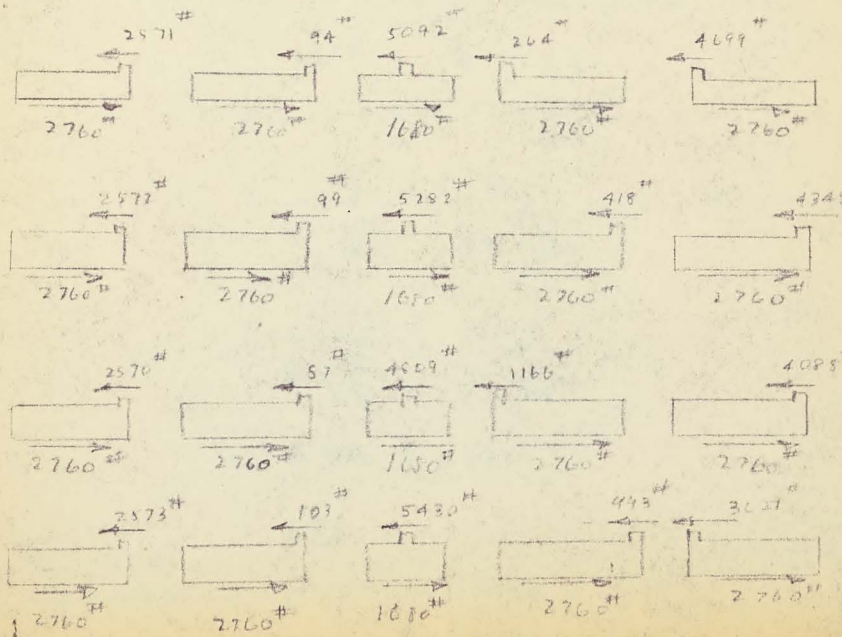
$$P_3 = 5175 + .257P_4$$

SUBST. IN (2).

$$27687 = 2.337P_4$$
$$26051 = 1.294P_4$$
$$1036 = 1.043P_4$$
$$P_4 = 993 \text{ LBS}$$

$P_3 = 5430$ LBS. $P_2 = 103$ LBS $P_1 = 2573$ LBS

$P_5 = 3621$ LBS.



FORM 1319A

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

REPORT No. 7/0558/45-2
SHEET No. 3-26

AIRCRAFT:		PREPARED BY	DATE
C 105	WING TO FUSELAGE HINGE.	C. DITCHFIELD	13 DEC 55
		CHECKED BY	DATE

ALUMINUM HINGE

MAX. LOAD = 4699#. P. 3-25 20% LOAD LEVEL.

MAX. LOAD ON ONE LUG = $\frac{4699 - 1532}{6} + 1532$

= 2060 LBS.

BENDING STRESS = $\frac{2060 \times .38}{.0421}$

= 17000 P.S.I.

FROM PETERSON'S "STRESS CONCENTRATION FACTORS" FIG. 60

$r = .12$ $D = 1.92$ $d = .96$

$\frac{r}{d} = .125$ $\frac{D}{d} = 2.0$

$K_t = 1.73.$

IN OTHER PLANE

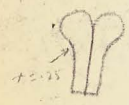


FIG. 57

$r = .25$ $D = 2 \times .57$ $d = 2 \times .30$

$\frac{r}{d} = .417$ $\frac{D}{d} = 1.9$

$K_T = 1.5$

ASSUMING

$$K_F = \frac{K_{T_1}}{1 + \frac{a_1}{\sqrt{b_1 r_1}}} \cdot \frac{K_{T_2}}{1 + \frac{a_2}{\sqrt{b_2 r_2}}}$$

AIRCRAFT ENGS. MARCH 1947

$$= \frac{1.73}{1 + \frac{.09}{\sqrt{.12}}} \times \frac{1.5}{1 + \frac{.09}{\sqrt{.15}}}$$

$= 1.372 \times 1.436$

$= 1.97$

P. 3-29

FROM FATIGUE CURVE AT $16.75 \times 10^3 \pm 16.75 \times 10^3$

MAX. FACTORED STRESS = 17000×1.97 GOOD FOR 1.65×10^6 CYCLES.

= 33,500 P.S.I.

ORM 1319A

A.V. ROE CANADA LIMITED MALTON - ONTARIO **TECHNICAL DEPARTMENT (Aircraft)**		REPORT NO. 7/0558/45-2 SHEET NO. 3-28	
AIRCRAFT:		PREPARED BY	DATE
C 105.	WING TO FUSELAGE HINGE	C. DITCHFIELD.	13 OCT 55.
		CHECKED BY	DATE

ASSUMING AIRCRAFT ENGG. MAR 1947.

$$K_F = \frac{K_{T_1}}{1+\frac{a_1}{\sqrt{b_1 t_1}}} \times \frac{K_{T_2}}{1+\frac{a_2}{\sqrt{b_2 t_2}}} \qquad \frac{1.46}{1+\frac{.03}{\sqrt{.11}}} \cdot \frac{1.15}{1+\frac{.03}{\sqrt{.5}}}$$

$$= \frac{1.85}{1+\frac{.03}{\sqrt{.05}}} \times \frac{1.44}{1+\frac{.03}{\sqrt{.25}}} \left(\frac{1.55}{1+\frac{.03}{\sqrt{.09}}} \cdot \frac{1.44}{1+\frac{.03}{\sqrt{.15}}}\right)$$

$$= 1.63 \times 1.36 \qquad (1.41 \times 1.36)\ (1.34 \times 1.105)$$

$$= 2.22 \quad (1.92) \quad (1.48)$$

MAX FACTORED STRESS = 98,250 × 2.22 (1.92) (1.48)

= 218000 (189,000). (145000).

[[illegible] DUAL RADIUS EFFECT [illegible] 98250. AT = 135000 psi]

FROM UNIVERSITY OF ILLINOIS BULLETIN No 334.

$$f_{ALT} = f_r \left[1 - \frac{f_{mean}}{f_{ult}}\right]. \qquad f_{ALT} = \text{ALTERNATING STRESS}$$

(MODIFIED GOODMAN CURVE EQU.).

IF $f_{ALT} = f_{MEAN}$ FOR STRESS RATIO = 0. f_R = REVERSED BENDING FATIGUE STRENGTH

$$f_{MEAN} = .48\, f_{ULT} \left[1 - \frac{f_{MEAN}}{f_{ULT}}\right]$$

.48 FACTOR COMES FROM PRODUCT ENGG. OCT. 1953 P 136 FOR 180.000 p.s.i.

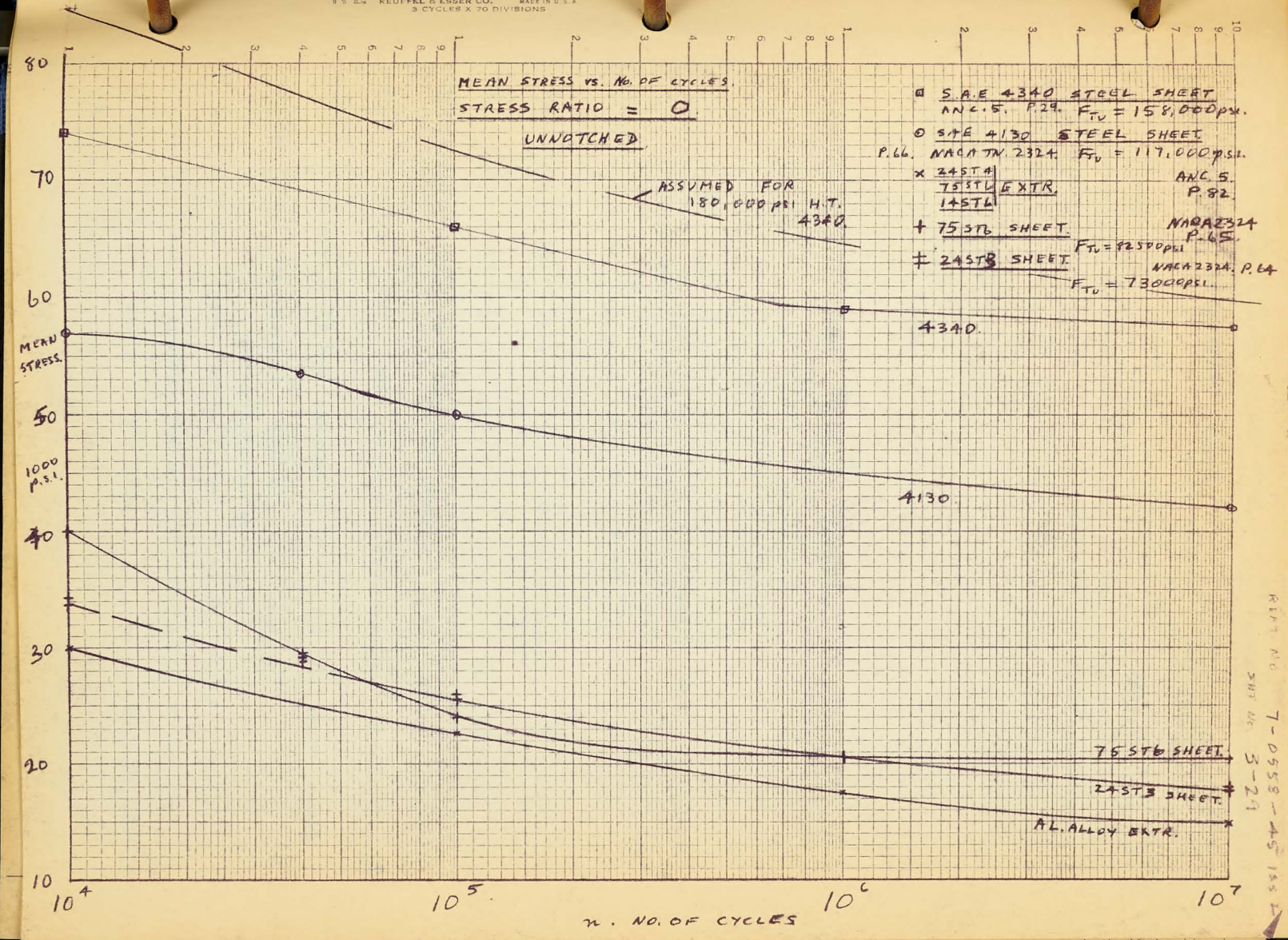
$$1.48\, f_{MEAN} = .48\, f_{ULT}$$

$$f_{MEAN} = .324\, f_{ULT}$$

FOR <u>180.000 psi.</u> f_{MEAN} = 58500 p.s.i AT 10^7 CYCLES.

MAX. ALLOW. STRESS = 117000 p.s.i. AT 10^7 CYCLES

(SAY) MAX. ALLOW. STRESS = <u>120,000 p.s.i</u> AT 2.5×10^6 CYCLES


SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS
MEAN STRESS vs. No. OF CYCLES.
STRESS RATIO = 0.
UNNOTCHED
ASSUMED FOR 180,000 psi H.T. 4340.
■ S.A.E 4340 STEEL SHEET
ANC.5. P.29. F_{TU} = 158,000psi.
○ SAE 4130 STEEL SHEET
P.66. NACA TN 2324. F_{TU} = 117,000p.s.i.
× 24ST4 75ST1 14ST6 EXTR. ANC. 5. P.82.
+ 75 ST6 SHEET. NACA2324 P.65. F_{TU} = 82500psi
‡ 24ST3 SHEET NACA2324. P.64 F_{TU} = 73000psi.
4340.
4130.
75 ST6 SHEET.
24ST3 SHEET.
AL. ALLOY EXTR.
MEAN STRESS. 1000 P.S.I.
80
70
60
50
40
30
20
10
10^4
10^5
10^6
10^7
n. NO. OF CYCLES

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

REPORT No. 7/0558/45-2
SHEET No. 3-30

AIRCRAFT:		PREPARED BY	DATE
C.105.	WING TO FUSELAGE HINGE.	C DITCHFIELD	16 DEC 55
		CHECKED BY	DATE

USING EN 30 STEEL HEAT TREATED TO 240,000 p.s.i.
FROM PROCT ENGG. OCT 1933 P.136.

$$f_r = .4\, f_{ULT}$$

THUS $1.4\, f_{MEAN} = .4\, f_{ULT}$

$$f_{MEAN} = \frac{.4}{1.4}\, 240000$$

$$= 68{,}500 \text{ psi}$$

MAX ALLOWABLE STRESS = 137,000 p.s.i AT 10^7 CYCLES
(SAT) = 141,000 p.s.i AT 2.5×10^6 CYCLES.

USING $T_1 = .12$ INS $T_2 = .5$ INS.

MAX. FACTORED STRESS = 145000 p.s.i P. 3-28.

AS THE MODIFIED GOODMAN CURVE IS RATHER PESSIMISTIC AT A STRESS RATIO = 0, THE ABOVE PART WILL BE ACCEPTED AS HAVING A SATISFACTORY FATIGUE LIFE (2.5×10^6 CYCLES) AT 20% ULT. LOAD WITH A STRESS RATIO OF ZERO.

X——————X

F.P. MITCHELL HAS DECIDED THAT THIS PART SHOULD BE MADE FROM 180,000 p.s.i STEEL, WHICH WOULD HAVE A MUCH LOWER FATIGUE LIFE (0.1×10^6 CYCLES) USING THIS ANALYSIS.

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

REPORT NO. 7/6553/45-2
SHEET NO. 3-31

AIRCRAFT:		PREPARED BY	DATE
C.105	WING TO FUSELAGE HINGE	C. DITCHFIELD	16 Dec 55.
		CHECKED BY	DATE

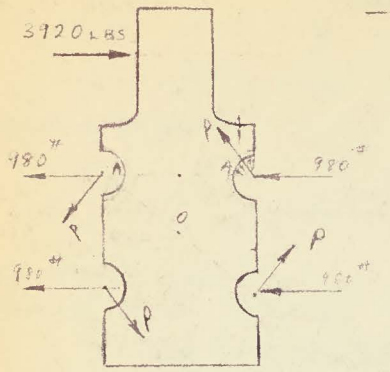
THIS ARRANGEMENT IS NO LONGER USED

CHECKING THE MAXIMUM FACTORED STRESS IN SECTION AA.

AT 20% LOAD LEVEL

LUG LOAD = 3920 LBS. P3-27.

BALANCING THIS AS SHOWN IN THE DIAGRAM.



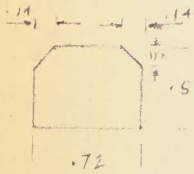
$M_o = 1.23 \times 3920$

$P = \dfrac{1.23 \times 3920}{4 \times .6}$

$= 2010$ LBS.

$M_{AA} = 3920 \times .83 - 2010 \times .4$

$= 2450$ IN LBS.



$I_{AA} = \dfrac{.72^3 \times .56}{12} - 2 \times .117 \times .14 \times \frac{1}{2} \times .32^2$

$= .0174 - .0017$

$= .0157$ IN^4.

$y = .36$

$f_b = \dfrac{2450 \times .36}{.0157} = 56,200$ p.s.i.

FROM PETERSON FIG 5.0.
$K_F = 2.12$

MAX. FACTORED STRESS = 119,000 p.s.i. SATISFACTORY FOR 16 x 10 MESH

FORM 1319A

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

REPORT NO. 7/C105/43-2
SHEET NO. 3-32

AIRCRAFT:		PREPARED BY	DATE
C.105.	WING TO FUSELAGE HINGE	C.D. ITEMFIELD	14 DEC 58.
		CHECKED BY	DATE

SUMMARY

FROM THE PRECEDING PAGES :-

AT 20% ULTIMATE LOAD

LIFE EXPECTANCY FOR ALUMINUM HINGE

= 1.65×10^6 CYCLES.

LIFE EXPECTANCY FOR STEEL HINGE (180,000 psi).
WITH $\frac{1}{2}$" SIDE RADIUS

= 0.10×10^6 CYCLES.

WITH 1" SIDE RADIUS

= 0.80×10^6 CYCLES.

FORM 1319A