

QCX
AVRO
CF105
R-7-0556-62
Iss-2



TECHNICAL REPORT



A. V. ROE CANADA LIMITED
MALTON - ONTARIO

ANALYZED

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT: C105

REPORT NO. 7/0556/62

FILE NO.

NO OF SHEETS 25

TITLE:

HYDRAULIC ACCESS DOOR

~~CONFIDENTIAL~~

Classification cancelled / Changed to UNCLASS

By authority of AVRS

Date 30 Sept 96

Signature [Signature]

Unit / Rank / Appointment AVRS

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DATE 9/20/55

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ISSUE NO	REVISION NO	REVISED BY	APPROVED BY	DATE	REMARKS
1	-	-	-	-	-
2	122	R. BOUHER		OCT. 56	INCOMPLETE WORK ON DOOR. CHANGE TITLE

15865842



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MALTON - ONTARIO

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AIRCRAFT:

C105

HYDRAULIC ACCESS DOOR
STRUCTURE

REPORT NO. 7-6356-22

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PAUL C. R.

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C 105

STRUCTURE -
HYDRAULIC ACCESS
DOOR AREA
C/S

REPORT NO.

7-0386-62

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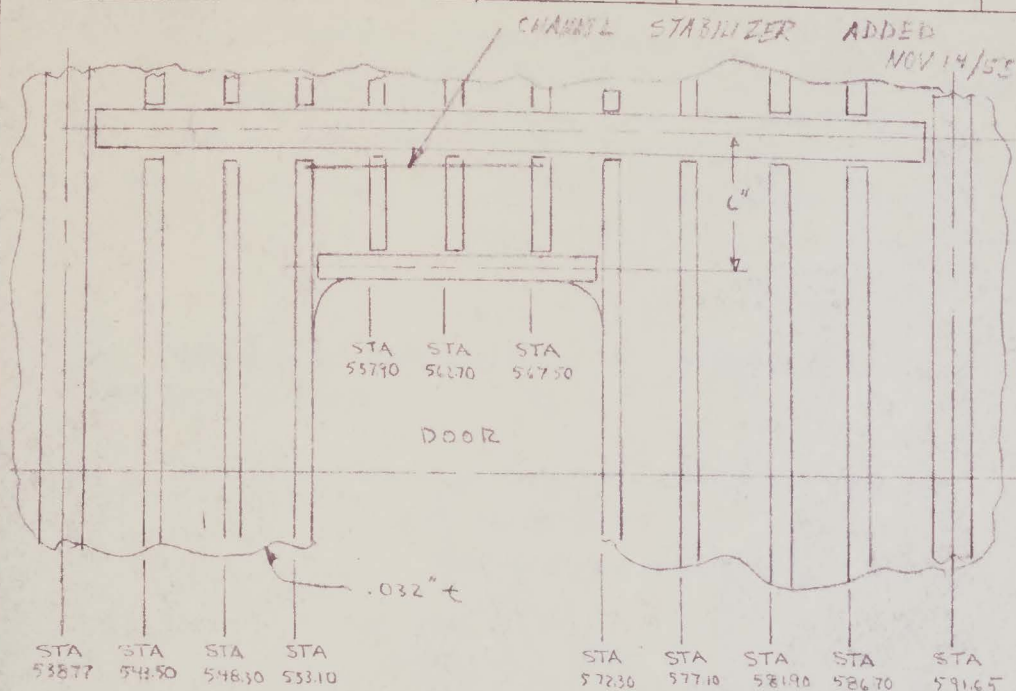
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THE DOOR BEAM EXTENDING B/T STAS.
55310 & 57230 - LOADING -

(a) MEMBRANE TENSION OF DOOR ACTS
THRU LOWER CAP INTO FUSELAGE
SKIN (.032 t). ACTING THRU DOOR D.B.R.
LOADING WILL BE ASSUMED UNIFORM
(LOADING IN DOOR ASSUMED PARABOLIC - SEE
PAGE 4).

$$\text{LOAD / in} = \left(2 \times \frac{2}{3} \times 8 + 2.6 + 3.3 \right) \times 6550 \times .032 / 15.5$$

$$= 166 \# / \text{in.}$$

(b) VERT LOAD DUE TO 5.5 PSI
DUE TO PRESSURE ON O/B SECTION (6")
OF FUSELAGE SKIN -

$$4.8 \times 3 \times 55 = 79 \# @ \text{ STAS } 557.90, 562.70,$$

$$\text{ \& } 567.50$$

* DISTANCE B/T END MEMS. RIV. & S. LOADING ASSUMED
UNIFORM.

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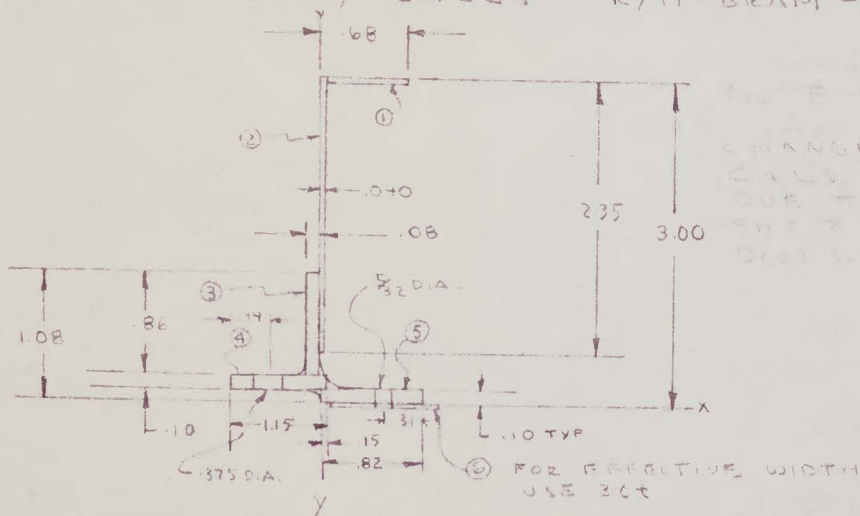
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(C) VERT PRESSURE LOADING FROM
DOOR - ASSUME CONCENTRATED LOADS
FOR BEAM BENDING (3 PLACES)
P = 327 * (SEE PAGE 5)
FOR LOCAL FLANGE BENDING

(D) SHEAR LOADING - 100 * / in. ON
BEAM LOWER CAP -

SECTION PROPERTY CALCS - R/H BEAM -



ITEM	A	X	Y	AX	AX ²	AY	AY ²	I _{ox}	I _{oy}
1	.0272	.36	2.80	.0098	.00350	.076	.213	—	.000865
2	.0924	.020	1.81	.0019	.00004	.167	.303	.0410	.00001
3	.0488	.040	.65	.00275	.00011	.0448	.0241	.00423	.00004
4	.1150	.425	.166	.04880	.02080	.0191	.0032	.00010	.01260
5	.082	.41	.05	.03360	.01330	.0041	.00021	.00007	.00450
6	.0310	.46	.016	.01410	.00656	.0005	—	—	.00266
Σ	.4164			.0081	.0448	.31050	.5485	.0454	.0207
- CAM LOC	.0375	.56	.017	.021	.0118	.00064	.00001	—	—
- RIV.	.0235	.51	.050	.0114	.0053	.00103	.00005	—	—
Σ	.3584			.0187	.0777	.3083	.5494	.0454	.0207

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STRUCT. HYDRAULIC
ACCESS DOOR
AREA
C/S

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SECTION PROPERTIES CONT'D -

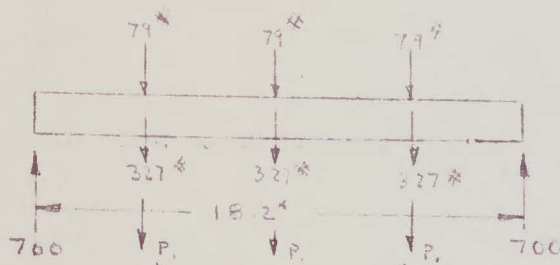
$$\bar{y} = .3089 / .3584 = .865$$

$$\bar{x} = .0187 / .3584 = .052$$

$$\bar{I}_x = (.0454 + .5484) - (.3089 \times .865) \\ = .327 \text{ in}^4$$

$$\bar{I}_y = (.0207 + .0277) - .0187 \times .052 \\ = .0387 \text{ in}^4$$

CONSIDERING BEAM BENDING LOADS ONLY -



WHERE:

$$P_1 = 276 / 4.5 \\ = 61 \times \text{SEE} \\ \text{P 16}$$

$\Sigma \text{MAX } M_b -$ SECONDARY LOADS SEE P. 16

$$700 \times 9.1 - 467 \times 4.8 = 4480 \text{ lb-in}$$

CHECKING COMP FLG. -

$$f_b = \frac{4480 \times 2.135}{.327} = 29300 \text{ PSI}$$

FOR LOCAL CRIPPLING TAKING COMP CHORD AS AN EFFECTIVE .68 x .68 ANGLE

$$F_{LC} = 33000 \text{ PSI}$$

$$f \text{ M.S.} = 33000 / 29300 - 1 = 1.12$$

TENSION IN LOWER CAP

$$f_b = 4480 \times .865 / .327 = 11850 \text{ PSI MAX}$$

SEE P 10 FOR CRITICAL M.S.

WITH COMBINED LOADINGS

X DIST CORAL

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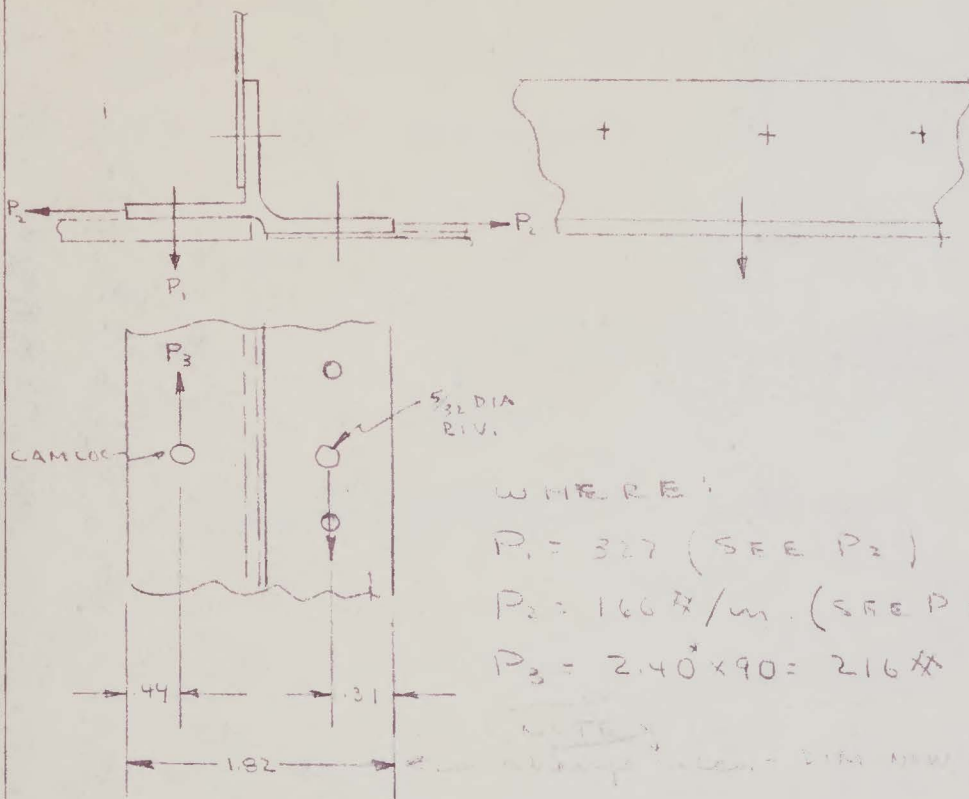
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CONSIDERING LOWER CAP - R/H BEAM



WHERE:

$$P_1 = 327 \text{ (SEE } P_2 \text{)}$$

$$P_2 = 166 \text{ lb/in. (SEE } P_1 \text{)}$$

$$P_3 = 2.40 \times 90 = 216 \text{ lb}$$

THE NORMAL LOAD OF 327 lb WILL BE ASSUMED TO HAVE A RESISTANCE OVER AN EFFECTIVE WIDTH $= \frac{2}{3} \times 240 = 1.6$ in.

$$\therefore I = \frac{1}{2} \times 1.6 \times 10^3$$

$$= 1335 \times 10^{-7}$$

*CAMLOC SP.

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LOAD/CAM LOC ASSUMING D.B.R. RIGID =

$$15.5 \times 17 \times 25.5 / 16 = 150 \times$$

USING CONCENTRATION FACTOR OF 1.5 @ STA. LOC.

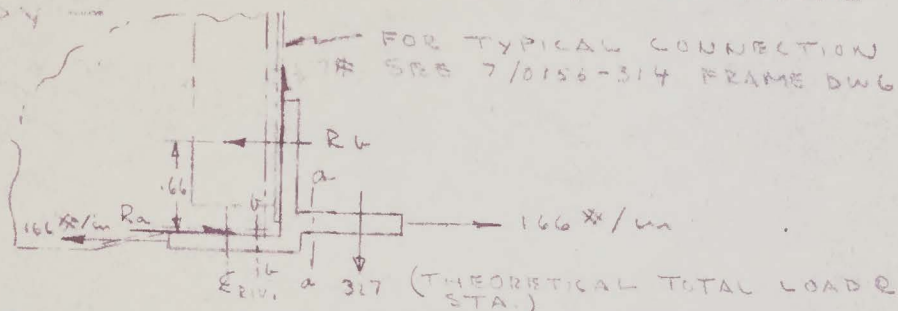
$$\text{LOAD/CAM-LOC} = 150 \times 1.5 = 225 \times$$

$$M_0 = 225 \times 141 = 92.3 \times \text{in} \quad \& \quad f_b = \frac{92.3 \times .05}{133.5 \times 10^{-6}} = 34600 \text{ PSI}$$

TENSILE STRESS ACROSS FLANGES =

$$166 / .10 = 1660 \text{ PSI}$$

CONSIDERING LOWER CAP AS FREE BODY



TOTAL TORQUE ABOUT C.G. OF CAP:

$$4.8 \times 166 \times 120 + 327 \times 155 = 276 \times \text{in}$$

$$R_B = R_A = 276 / .66 = 418 \times$$

TOTAL RIVET LOAD AT R_A @ STA. TIE

$$166 \times .54 - 418 = 328 \times \text{SHEAR} \leftarrow \text{O/B}$$

& RIV. THRU WEB TIE OF SUB STRUC.

$$= 327 \text{ SHEAR} \& 418 \times \text{TENSION.}$$

BENDING OF UPSTANDING LEG ABOUT FILLET:

$$M = 418 \times .54 = 226 \times \text{in}$$

TAKING I OF EFFECTIVE SECTION

$$= \frac{1}{2} \times 4.8 = 2.4$$

$$I = \frac{1}{12} \times 2.4 \times .10^3 = 200 \times 10^{-6}$$

* 4.8 = SPACING OF STIFFENERS Δ RIV. SP.

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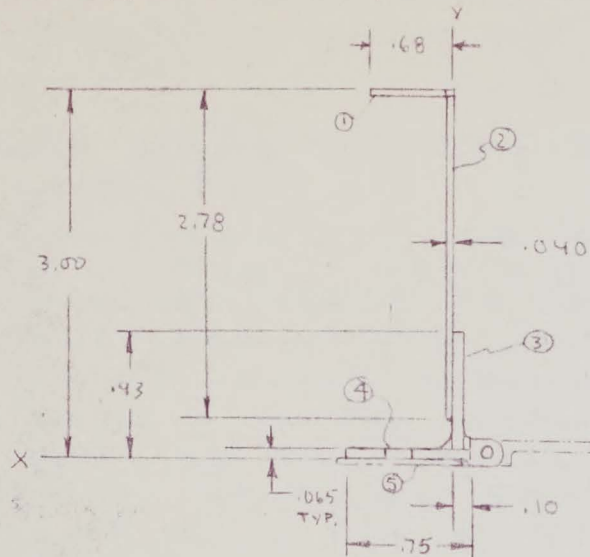
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SECTION PROPERTY CALCS, LH/BEAM -



NOTE:
THIS SECTION
WAS SIMILAR
TO LH BEAM
3BB SH2
HYDRAULIC
DISC DRIVE

ITEM	A	X	Y	AX	AX ²	AY	AY ²	I _{ox}	I _{oy}
1	.0272	.36	2.80	.0098	.00350	.076	.212	—	.00087
2	.0924	.020	1.63	.00185	.00004	.1510	.2460	.0717	.00001
3	.0558	.032	.50	.00179	.00006	.0279	.0139	.00344	.00002
4	.0488	.280	.032	.01370	.00383	.00156	.00005	.00001	.00226
5	.0310	.480	.016	.01490	.00710	.00044	—	—	.00275
Σ	.2552			.03846	.01453	.2560	.473	.0752	.00591
- DIV.	.0151	.34	.0165	.00514	.00175	.0002	—	—	—
Σ	.2400			.03332	.01278	.2558	.473	.0752	.00591

$$\bar{Y} = .2558 / .2400 = 1.06''$$

$$\bar{X} = .0333 / .2400 = .138''$$

$$\bar{I}_x = .0752 + .473 - .2558 \times 1.06$$

$$= .278 \text{ in}^4$$

$$\bar{I}_y = .00591 + .01278 - .0333 \times .138$$

$$= .0141 \text{ in}^4$$

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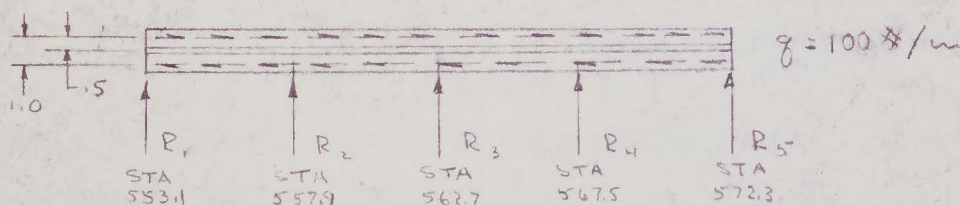
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THEN BENDING ABOUT FILLET -

$$\frac{226 \times 0.04}{200 \times 10^{-6}} = 45200 \text{ PSI (ON UPSTANDING LRG)}$$

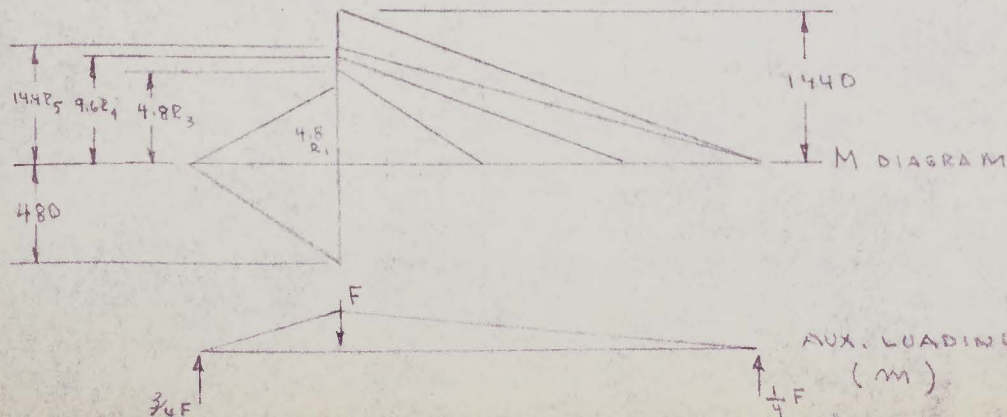
CAP LOCAL BENDING DUE TO SHEAR
LOADS P_3 -

THE SKIN WILL BE CONSIDERED IN-
EFFECTIVE IN RESISTING APPLIED LOAD.
THE RESISTANCE TO LOADING WILL BE
SUPPLIED AT STA LOCS. & THE STRUC.
IS 3rd DEGREE REDUNDANT. THE APPLIED
LOAD WILL BE SIMPLIFIED AS AN
APPLIED CONTINUOUS SHEAR SINCE
THE CRITICAL SECTIONS OF LOWER
CAP WILL OCCUR AT STA RESISTANCE
PTS. -



USING "ELASTIC ENERGY THEORY" VANDEN BROEK

(a) EQ. FOR $\delta_{R2} = 0 = \sum M m dx$



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$$M_0 \text{ MAX} = 1300 \text{ } \# \text{ } \text{in.}$$

I (REF. P 2) -

$$\bar{X} = \frac{(-.00275 - .04880 + .03360)}{(.2658 - .0575)}$$

$$= -.00548 / .208 = -.0264 \text{ "}$$

$$\bar{I}_y = .0171 - .0171 + .0346 - .208 \times .0264^2$$

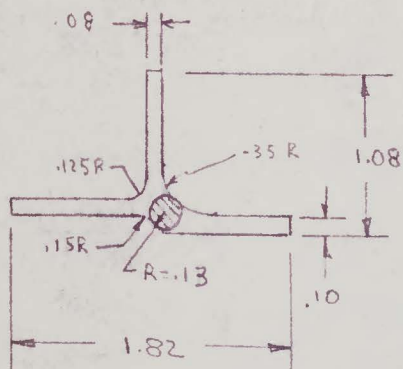
$$= .0344 \text{ in}^4$$

$$\therefore f_b = \frac{1300 \times .88}{.0344 \times} = 34200 \text{ PSI TENSION OR COMP.}$$

BEFORE CHECKING STRENGTH OF BOTTOM CAP, THE TORSIONAL SHEAR STRESSES WILL BE INVESTIGATED -

$$\text{TOTAL TORQUE} = 276 \text{ } \# \text{ } \text{in. (P 5)}$$

FINDING TORQUE SHEAR CONSTANTS -



MAX T @ PT OF TANGENCY OF .15R & INSCRIBED CIRCLE

$$J = J_F + J_W + 16 \alpha R^4$$

WHERE $J_F =$

$$ab^3 \left[\frac{1}{3} - .21 \frac{b}{a} \left(1 - \frac{b^4}{12a^4} \right) \right]$$

$$= 1.82 \times .001 \left[\frac{1}{3} - .21 \times .055 \left(1 - \frac{.0001}{12 \times 1.82^4} \right) \right]$$

$$= .000587 \text{ in}^4$$

$$J_W = cd^3 \left[\frac{1}{3} - .105 \frac{d}{c} \left(1 - \frac{d^4}{192c^4} \right) \right]$$

$$= .86 \times .0005 \left[\frac{1}{3} - .105 \times .043 \left(1 - \frac{.000041}{192 \times .55^4} \right) \right]$$

$$= .000140 \text{ in}^4$$

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$$K = .08 / .10 = .8$$

$$\begin{aligned} \alpha &= K (.15 + .10 \%) \\ &= .8 (.15 + .10 \times .125 / .10) \\ &= .220 \end{aligned}$$

$$\begin{aligned} J &= J_F + J_w + 16 \alpha R^3 \\ &= .000587 + .00140 + 16 \times .220 \times .13^3 \\ &= .008827 \text{ in}^4 \end{aligned}$$

$$\tau_{\text{MAX}} =$$

$$\frac{2R}{1+m^2} \left[1 + \tanh \frac{2B}{\pi} \left\{ .118 \log_e (1 - R/p) - .238 R/p \right\} \right] \frac{T}{J}$$

$$p = 7.12 \quad R = .13 \quad R/p = -1.08$$

$$(1 - R/p) = 2.08 \quad .238 \times R/p = -.258$$

$$\log_e 2.08 = .7134 \quad .118 \log_e 2.08 = .0840$$

$$B = 90^\circ \quad \therefore 2B/\pi = 1.0$$

$$\tanh 2B/\pi = .762$$

$$\begin{aligned} \left\{ .118 \log_e (1 - R/p) - .238 R/p \right\} &= .0840 + .258 \\ &= .342 \end{aligned}$$

$$m = \pi R^2 / A =$$

$$= \pi \times .13^2 / .208 = .255$$

$$1 + m^2 = 1.065 \quad \& \quad 1 + m^2 = 1.065$$

$$2R / (1 + m^2) = .26 / 1.065 = .244$$

$$\tau_{\text{MAX}} = .244 [1 + .762 \times .342] \frac{T}{J}$$

$$= .308 \frac{T}{J} = .308 \times 276 / .008827$$

$$= 9650 \text{ PSI SHEAR DUE TO}$$

TORQUE.

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1-12

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CHECKING STR OF R/H BRAM LOWER CAP -
FROM PAGE (2) $f_b = 34200$ PSI TENSION OR COMP
FROM PAGE (3) $f_b = 11850$ TENSION
 $\Sigma = 45050$ PSI
FROM PAGE (5) $f_t = 1660$ PSI TENSION
FROM PAGE (9) $f_s = 0$ AT EDGE
FROM FIG 1 $f_s = 370/208 = 1780$ PSI

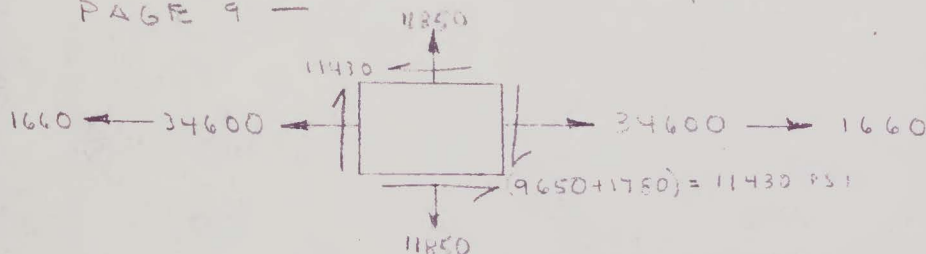
$$\# M.S. = 78000 / 45050 - 1 = +.73$$

BENDING & SHEAR ABOUT FILLET (SEE SECTION
a-a PAGE 5)

$$M = 225 \times .41 = 90 \text{ in} \quad (\text{SEE P 5})$$

$$\# f_b = 34600 \text{ PSI} \quad \text{" "}$$

TAKING SHEAR STRESS MAX PER
PAGE 9 -



$$\sigma_{\max} = \frac{34600 + 11850}{2} + \sqrt{\left(\frac{25410}{2}\right)^2 + 11430^2}$$

$$= 42410 \text{ PSI}$$

$$\# M.S. = 78000 / 42410 - 1 = +.84$$

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CHECKING BENDING ABOUT FILLET OF
UPSTANDING LEG -

$$f_b = 45200 \text{ PSI (P 6)}$$

$$f_s = 9650 \text{ PSI (P 9)}$$

$$f_t = 225^* / 2.4 \times .08 = 1170 \text{ PSI}$$

$$\sigma_{\text{MAX}} = 23185 + \sqrt{23185^2 + 1170^2}$$
$$= 46385$$

$$\& \text{ M.S.} = 78000 / 46385 - 1 = +.68$$

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CHECKING BENDING OF LOWER R/H
BEAM CAP @ SECTION d-b (SER P 5)
SINCE VERTICAL REACTION @ CAM LOC
IS TAKEN THRU WEB @ RIVS. BENDING
IS NOT CRITICAL -

CHECKING CRIPPLING OF HORIZ. FLG.

$$f_b = 34200 \text{ PSI (P 8)}$$

$$F_{CL} = 65000 \text{ PSI (REPUBLIC CURVE)}$$

$$\therefore M.S. = 65000 / 34200 - 1 = +.90$$

FROM ABOVE MARGINS BOTTOM CAP OF
R.H. BEAM IS O.K. -

CHECKING L/H BEAM LOWER CAP -

SECTION PROPERTIES - (REF. P 6)

ITEM	A	x	Ax	Ax ²	I _{oy}
3	.0558	-.032	-.000179	.00001	.00002
4	.0488	.280	.01370	.00383	.00226
Σ	.1046		.0135	.00384	
- Riv.	.0101	.34	-.00514	.00175	—
Σ	.1045		.00836	.00209	.00228

$$\bar{x} = .00836 / .0945 = .088$$

$$I_y = .00228 + .00209 - .00836 \times .088$$

$$= .00464 \text{ in}^4$$

CHECKING LOWER CAP FOR ECCENTRIC
AXIAL SHEAR

$$g = 100 \text{ lb/in}$$

$$M = 100 \times .55 = 55 \text{ lb-in/in}$$

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PER ANALYSIS OF LOWER R/H CAP AS
CONTINUOUS BEAM P-6 -

EQ (1) BECOMES

$$40.35 R_1 + 13.5 R_4 + 12220 = 0$$

EQ (2) -

$$19.2 R_1 - 9.6 R_4 + 1055 = 0$$

$$R_1 = 13705 / 67.35$$

$$= -204 \text{ \#}$$

$$R_4 = 29605 / 9.6 = 308 \text{ \#}$$

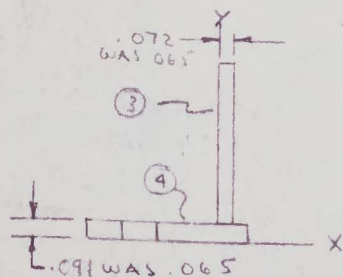
$$M_{\max} = 204 \times 4.8 - 55 \times 4.8$$

$$= 715 \text{ \#m.}$$

$$f_b = 715 \times .572 / 464 \times 10^{-5}$$

$$= 88000 \text{ PSI}$$

CHOOSING NEW SECTION FOR LOWER
CAP L/H BEAM - (REF. P 6)



ITEM	A	x	Ax	Ax ²	I _{oy}
B	.0597	.036	.00217	.00008	.00003
4	.0683	.280	.01920	.00537	.00307
Σ	.1280		.01703	.00545	.00310
-RIV	.0142	.34	.00482	.00165	—
Σ	.1138		.01221	.00480	.00310

$$\bar{X} = .01221 / .1138 = .108 \text{''}$$

$$\bar{I}_y = .00310 + .00480 - .01221 \times .108$$

$$= .00668 \text{ in}^4$$

$$f_b = 715 \times .542 / .00668 = 58100 \text{ PSI}$$

‡

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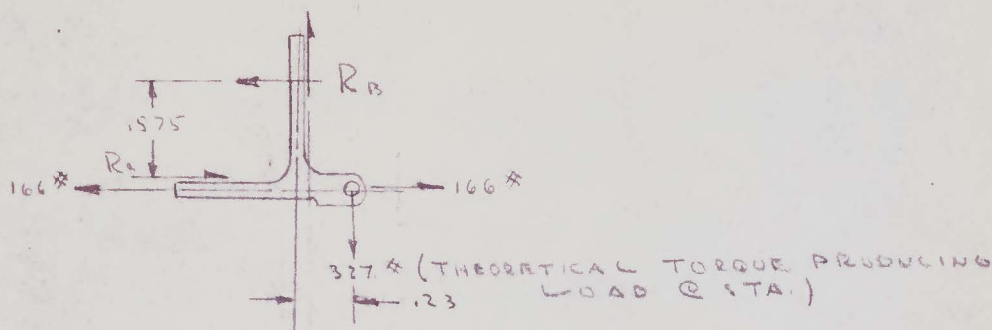
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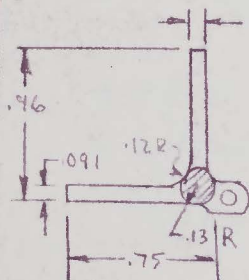
NEXT CONSIDERING TORQUE LOADING ON
BOTTOM CAP L/H BEAM - (SEE P5)



TOTAL TORQUE ON CROSS SECTION -
= $327 \times .23 = 75 \text{ in.}$

$$R_B = R_a = 75 / .575 = 131$$

SOLVING FOR TORQUE SHEAR CONSTANTS -



$$J = J_F + J_W + 16 \alpha R^4$$

WHERE:

$$J_F = a b^3 \left[\frac{1}{3} - 0.21 \frac{b^4}{a} \left(1 - \frac{b^4}{12 a^4} \right) \right]$$

$$= .75 \times .00075 \left[\frac{1}{3} - .21 \times .121 \left(1 - \frac{.000068}{12 \times .32} \right) \right]$$

$$= .000173 \text{ in}^4$$

$$J_W = c d^3 \left[\frac{1}{3} - .105 \frac{d^4}{c} \left(1 - \frac{d^4}{192 c^4} \right) \right]$$

$$= .87 \times .000236 \left[\frac{1}{3} - .105 \times \frac{.072}{.87} \left(1 - \frac{.000026}{192 \times .57} \right) \right]$$

$$= .0000667 \text{ in}^4$$

$$\alpha = \frac{b}{d} \left(.07 + .076 \times \frac{.12}{.091} \right) = \frac{.091}{.072} (.177)$$

$$= .224$$

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AIRCRAFT:

C 105

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$$f_b = \frac{72.2 \times .072}{2 \times 72 \times 10^{-6}} = 36100 \text{ PSI}$$

CHECKING BEAM BENDING WITH REVISED
LOWER CAP - REF P 6 -

ITEM	A	X	Y	Ax	Ax ²	Ay	Ay ²	I _{ox}	I _{oy}
1	.0272	.36	2.80	.00480	.00350	.076	.213	—	.00087
2	.0924	.020	1.63	.00185	.00004	.1510	.2460	.0717	.00001
3	.0597	.082	.50	.00217	.00008	.02985	.01493	.00355	.00003
4	.6683	.280	.032	.01920	.00537	.00218	.00007	.00005	.00307
5	.0310	.480	.016	.01490	.00710	.00050	—	—	.00275
Σ	.2786			.01358	.01609	.2586	.474	.0753	.00673
- RIV.	.0193	.34	.0165	.00656	.00223	.00032	—	—	—
Σ	.2593			.03702	.01886	.2583	.474	.0753	.00673

$$\bar{X} = .03702 / .2593 = .143''$$

$$\bar{Y} = .2583 / .2593 = 1.00''$$

$$\bar{I}_x = .474 + .0753 - .2583$$

$$= .291 \text{ in}^4$$

$$\bar{I}_y = .00673 + .01886 - .03702 \times .143$$

$$= .0153 \text{ in}^4$$

$$f_b = \frac{4060^* \times 2}{.291} = 28000 \text{ PSI}$$

FOR COMP FLG. $F_{LL} = 33000$ (REF. P 3)

$$\& M.S. = 33000 / 28000 - 1 = +.18$$

SEE P FOR UPPER CHORD CHECK
AS COLUMN.

* SEE P 16

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TOTAL STRESS AT FILLET OF UPSTANDING
LEG -

$$f_b = 36100 \text{ T}$$

$$f_s = 16100$$

$$f_t = 1170 \text{ PSI SEE P(10A) ,}$$

$$\sigma_{\text{MAX}} = 18635 + \sqrt{18635^2 + 16100^2}$$

$$= 43435 \text{ PSI T}$$

$$\text{M.S.} = 78000 / 43435 - 1 = +.80$$

TOTAL STRESS @ EDGE OF SKIN FLG. -

$$f_b = 58100 \text{ PSI T}$$

$$f_{b_1} = 14000 \text{ PSI T}$$

$$\Sigma = 72100$$

$$\text{M.S.} = 78000 / 72100 - 1 = +.08$$

CHECKING CRIPPLING -

$$f_b = 58100$$

$$F_{LL} = 65000 \text{ (REPUBLIC CURVES)}$$

$$\text{M.S.} = 65000 / 58100 - 1 = +.11$$

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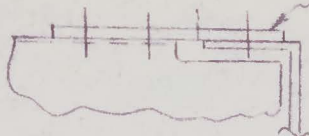
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CAP STABILIZED AT STA 562.7 -

ADD .072 PLATE $\frac{3}{4}$ WIDE



THEN:

$$\frac{L}{r} = \frac{9.1}{.213} = 42.8$$

* $F_{COL} = 40000 \text{ PSI}$ (REPUBLIC CURVE)

* USE $F_{CL} = 33000$

$$\& \text{ M.S.} = \frac{33000}{29300} - 1 = +.12$$

CHECKING ENDS OF BEAM FOR SHEAR
TRANSFER -

USING (3) AD4 RIVS:

$$\text{LOAD/RIV.} = 700/3 = 233 \&$$

$$P_{ALLOW} \text{ AD4 IN } 032" = 365$$

$$\therefore \text{ M.S.} = \frac{365}{233} - 1 = +.57$$

CHECKING BEAM WEBS FOR SHEAR -

$$\text{LOAD}/w. = 700/21 = 333 \&/w.$$

F_{CR} (BUCKLING) =

PANEL WIDTH = 2.1 $E = 1040$

LENGTH = 4.8

$$\therefore f_{cr} = 28500 \text{ PSI (REPUBLIC CURVE)}$$

$$\& \text{ } f_{allow} = 28500 \times .04 = 1140 \&/w.$$

$$\& \text{ M.S.} = \frac{1140}{333} - 1 = +2.4$$

* DIST B/T UPPER CHORD C.G. & LOWER CHORD RIVS -

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TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:

REPORT NO. 7-0526-62

SHEET NO. 1-20

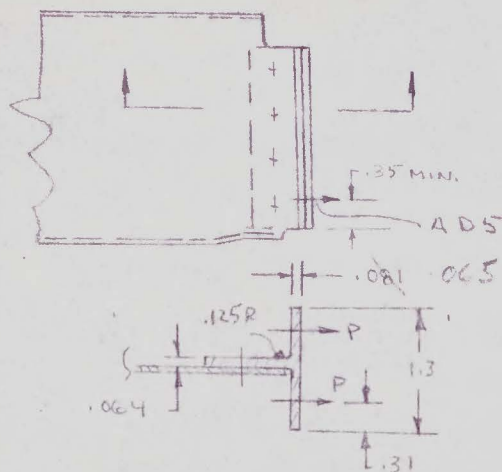
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DUE TO HIGH LOCAL LOADING ON
RIV. THRU UPSTANDING LEG (SEE P 5)
THE CONNECTION OF STUB STIFFS.
TO BEAMS WILL BE REVISED -



$$\text{WHERE: } P = 418 / 2 = 209 \text{ \#}$$

ASSUMING EFFECTIVE WIDTH = .7"

$$I = \frac{1}{12} \times .7 \times .081^3 = 319 \times 10^{-7}$$

$$M = 209 \times .13 = 62.7$$

$$f_b = \frac{62.7 \times .0405}{319 \times 10^{-7}} = 79500 \text{ PSI}$$

$$M.S. = 78000 / 79500 - 1 = -.02$$

WITHOUT REGARD FOR SECTION FORM
FACTOR M.S. IS ADEQUATE.

LOCKHEED STRESS MANUAL

$$t = .065 \text{ 75576} \quad C = .31$$

$$\text{ALLOW } P = 250 + \frac{70000 F_{TY}}{40000} = 437 \text{ \#}$$

$$M.S. = \frac{437}{209} - 1$$

1.0

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AIRCRAFT:

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$$M.S. = 450/293 - 1 = +1.53$$

CHECKING TENSION RIV. -

$$F_t = 750^* \text{ (REF. GLM RIV. TENSION ALLOW.)}$$

$$F_s = 590$$

$$R_t = \frac{218}{750} = .291$$

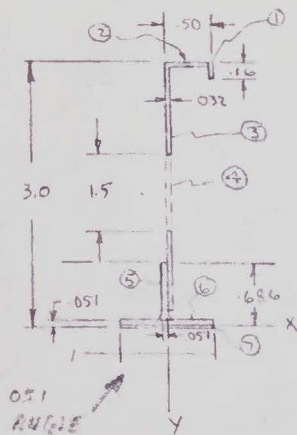
$$R_s = \frac{140}{590} = .238$$

$$M.S. = \frac{1}{\sqrt{R_t^2 + R_s^2}} - 1 \text{ (CONSERV.)}$$

$$= \frac{1}{\sqrt{.291^2 + .238^2}} - 1 = \frac{1}{.377} - 1 = +1.65$$

FOR BENDING CHECK OF END TEE SEE P 21
REPORT - - - - -

CHECKING BENDING OF STUB STIFFENER -



ITEM	A	Y	AY	AY ²	I _{ox}
1	.051	2.92	.0149	.0435	—
2	.0160	2.98	.0476	.1420	—
3	.090	1.60	.1440	.2300	.058
4	.048	1.50	.072	.1080	.009
5	.032	.368	.0118	.0043	.0011
6	.051	.025	.0013	—	—
7	.099	.016	.0016	—	—
Σ	.2431		.2212	.3112	.0501
- RIV.	.026	.016	.0026	.0003	—
Σ	.2671		.2186	.3115	.0501

$$\bar{Y} = .2186 / .2671 = .82$$

$$\bar{I}_x = .0501 + .3115 - .2671 \times .82$$

$$= .1426 \text{ in}^4$$

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TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0226-62

SHEET No. 1-29

AIRCRAFT:

C105

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COMP IN BOTTOM CAP -

MAX $M_x = 276 \text{ K-in}$ AT INBOARD

FOR FULL BRAM SECTION (REF. P 2)

$$A = .3631 \quad A_y^2 = .5275$$

$$A_y = .3626 \quad I_{ox} = .0681$$

$$\therefore \bar{Y} = \frac{.3630}{.3626} = 1.0$$

$$I = .0681 + .5275 - .3631 \times 1.0$$

$$= .2325$$

$$f_b = \frac{276 \times 1}{.2325} = 1190 \text{ PSI C}$$

$$f_c = \frac{745}{.3631} = 2050 \text{ C}$$

$$\Sigma = 3240 \text{ PSI C}$$

$F_{cr} = 24000$ FOR LOWER CAP SKIN PLGS.

$$\therefore \text{M.S.} = 24000 / 3240 = +6.5$$

CHECKING WEB SHEARS -

$$f_s = 140 / .032(3-1.5) = 2920 \text{ PSI}$$

WEB COLLAPSING SHEAR* -

$$\tau = k \left[\tau_h \left(1 - \left(\frac{D}{h} \right)^2 \right) + \tau_c \sqrt{\frac{D}{h}} \right] \frac{C' / 10}{2.25}$$

$$= .797 \left[14000 \left(1 - .287 \right) + 22700 \times .686 \right] \frac{1.25}{2.25}$$

$$= .797 \left[25600 \right] .555$$

$$= 11300 \text{ PSI}$$

$$\therefore \text{M.S.} = 11300 / 1460 = +7.8$$

TECHNICAL DEPARTMENT (Aircraft)

510

REPORT NO.

SHEET NO.

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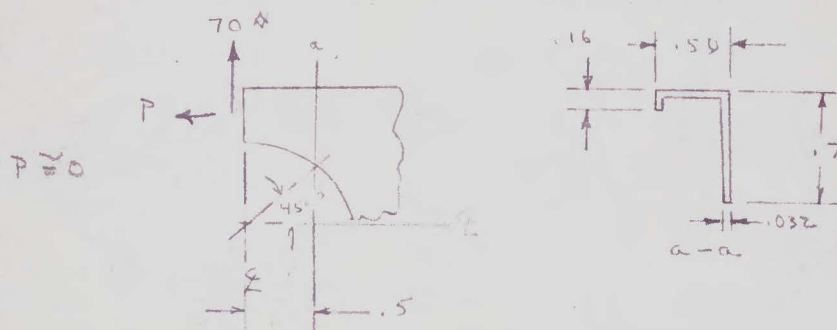
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CHECKING UPPER FLG

$$f_b = \frac{276 \times 2}{1.2325} = 2380 \text{ PSI } T \text{ (NEGLECTABLE)}$$

IN REGION OF LIGHTING HOLE -



SECTION 12 PROPERTIES (REF P 2)

$$A \approx .0425 \quad \Delta y^2 \approx .3375$$

$$A_y = .1195 \quad \sum I_{ox} = .0008$$

$$M = 35$$

$$\overline{y}' = .1195 / .0425 = 2.82$$

$$\begin{aligned} \bar{I}_x' &= 10008 + 3375 - .1195 \times 2.82 \\ &= 10023 \end{aligned}$$

$$f_b = \frac{35 \times .18}{10023} = 27400 \text{ PSI COMP. UPPER FLG.}$$

F_{cc} FOR $\frac{1}{2}$ " PORTION OF FLG. = 67500 PSI

(REPUBLIC HAWAII)

$$MS = 67500 / 27400 = 2.46$$

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0576 62

SHEET NO. 2-1

AIRCRAFT:

C105

ACCESS DOOR
HYDRAULIC -
C/S

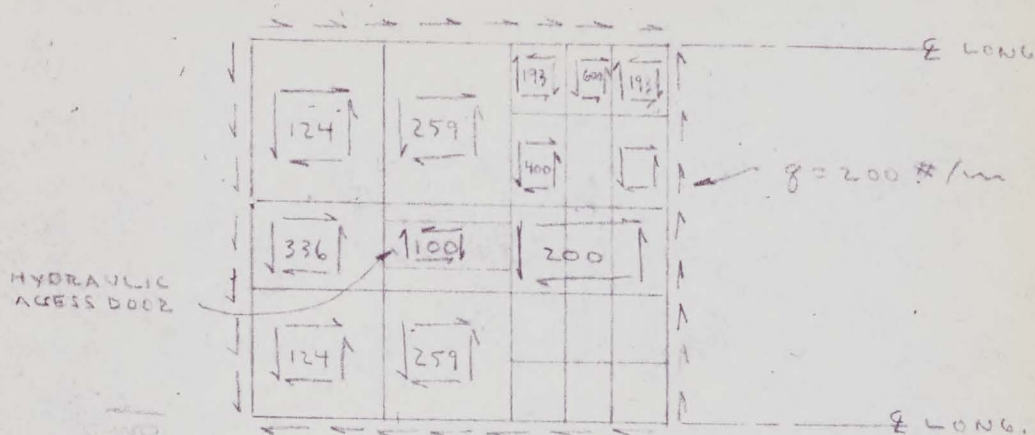
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THE LOADING SYSTEM FOR LOWER SKIN IS AS FOLLOWS -



IN ADDITION TO THE ABOVE GENERAL LOADING A PRESSURE DIFFERENTIAL OF 5.5 PSI IS ACTING ON DOOR AREA.

CHECKING STRESS IN DOOR SKIN -

A CERTAIN ADDITIONAL TENSION LOAD WILL BE ASSUMED ACTING IN CONCERT WITH THE MEMBRANE EFFECTS OF THE 5.5 PSI LOADING. SINCE AT STA 485 NO LOWER SKIN IS AVAILABLE THE SKIN TENSION STRESS WILL BE ZERO AT THIS POINT (DUE TO ANY NEG. FUSELAGE BENDING)

FROM "DIVE BRAKE BAY STA 499.7 - 524.2" REPORT NO. AN EFFECTIVE SKIN TENSION OF 2858 PSI WAS CALC. AT STA 538. THEREFORE BY SIMILAR REASONING - ASSUMING SKIN PANELS CAN ACCEPT ONLY THE UPPER LIMIT OF CRITICAL BUCKLING SHEAR (758/in).

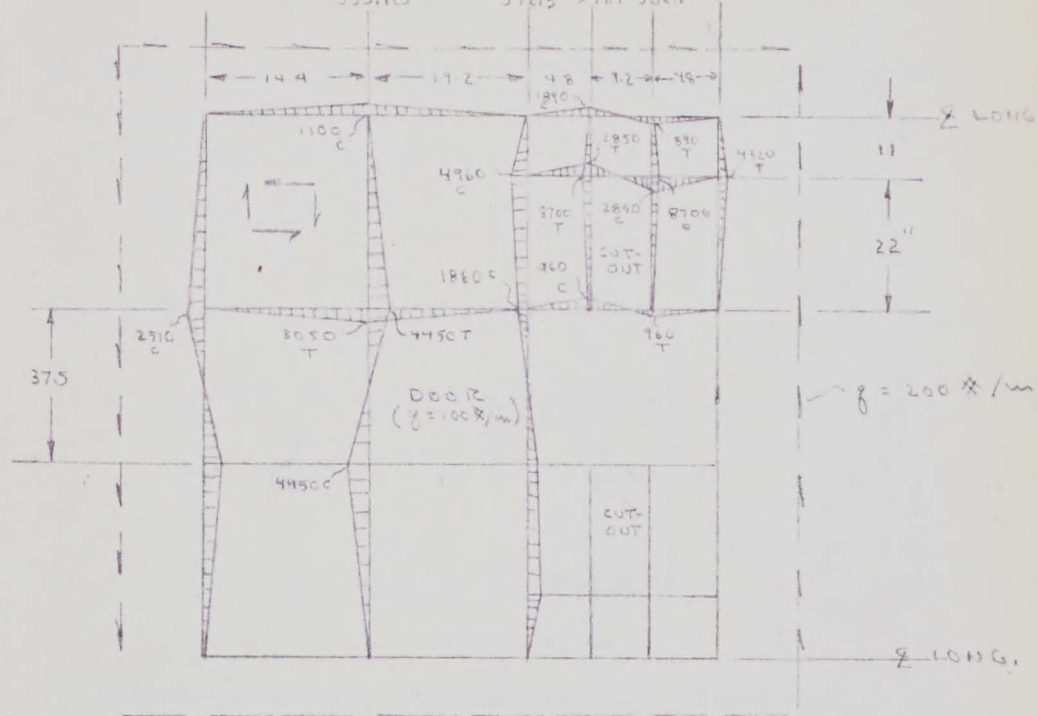
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2105

DATE _____

DATE _____

STA. 538.77	STA 553.10	STA 572.3	STA 572.1	STA 586.7	STA 591.65
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ABOVE LOADINGS ARE REVERSIBLE
AXIAL LOADINGS ARE LOADS APPLIED
TO STIFFENING MEMBERS.

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TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0556-62

SHEET No. 2-3

AIRCRAFT:

C105

ACCESS DOOR -
HYDRAULIC
C/S

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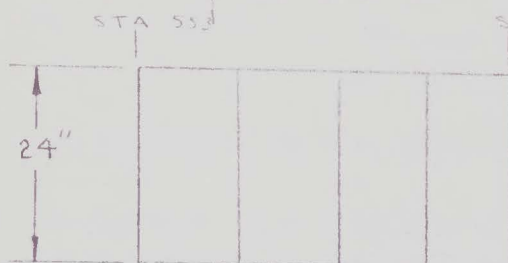
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THEN MAX SHEAR FROM LONGERON
PER SIDE = $75(591.65 - 538.77) + 4030$
= 8030 #

TENSILE STRESS = $8030 / 1.6 = 5000$ PSI
ASSUMING 2/3 OF THIS LOAD ACTS AT
CENTER OF DOOR.

$f_t = 3330$ PSI

CHECKING MEMBRANE EFFECTS ON DOOR -



$t = .032$
 $b = 4.8$
 $a = 24.0$
 $E = 10.5 \times 10^6$
 $p = 5.5$ PSI

4.8"

THEN USING RAS. DATA SHEETS
02.09.01 & 02.09.02 -

FOR EDGES FREE TO ROTATE -

$$(p/E) (b/t)^4 = \left(\frac{5.5}{10.5 \times 10^6} \right) \left(\frac{4.8}{.032} \right)^4 = 265$$

$$E (t/b)^2 = 10.5 \times 10^6 \left(.032 / 4.8 \right)^2 = 467$$

$$a/b = 24.0 / 4.8 = 5.0$$

FROM CURVES -

$$f_1/E (b/t)^2 = 24.3$$

$$f_3/E (b/t)^2 = 14$$

$$f_1 = 24.3 \times 467 = 11350 \text{ PSI}$$

$$f_3 = 14.0 \times 467 = 6550 \text{ PSI}$$

WHERE f_1 IS TENSION (MAX.) @ CENTER OF
PLATE & f_3 IS MEMBRANE TENSION.

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TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-3356-62

SHEET No. 2-4

AIRCRAFT:

C.105

ACCESS DOOR
HYDRAULIC
C/S

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CONSIDERED PLATE AS HAVING FIXED
EDGES & USING CURVES ON R.A.S. DATA
SHEET 02.09.02 -

FOR ABOVE CONSTANTS

$$f_1/E(b/t)^2 = 23.2 \quad \therefore f_1 = 10850 \text{ PSI}$$

$$f_2/E(b/t)^2 = 71.0 \quad \therefore f_2 = 33200 \text{ PSI}$$

$$f_3/E(b/t)^2 = 10.5 \quad \therefore f_3 = 4900 \text{ PSI}$$

WHERE:

f_1 = MAX STRESS @ CENTER OF PLATE

f_2 = " " @ MID POINT OF LONG SIDE

f_3 = MEMBRANE TENSION

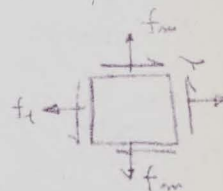
THE HIGHER STRESSES DUE TO A
FIXED EDGE CONDITION WILL BE
USED FOR MEMBRANE EFFECTS.

CHECKING PRINCIPLE STRESSES IN
SKIN -

$$f_t = 33200 + 3330 = 36500 \text{ PSI}$$

$$\tau = 100 / 0.32 = 3130 \text{ PSI}$$

$$f_m = 4900$$



$$\sigma_{\text{MAX}} = \frac{36500 + 4900}{2} + \sqrt{\left(\frac{36500 - 4900}{2}\right)^2 + 3130^2}$$

$$= 36800 \text{ PSI}$$

$$\% \text{ M.S.} = 58000 / 36800 - 1 = +.57$$

* Ftu @ 250° F (REF ANG-5)

TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0556-02

SHEET No. 2 - 5

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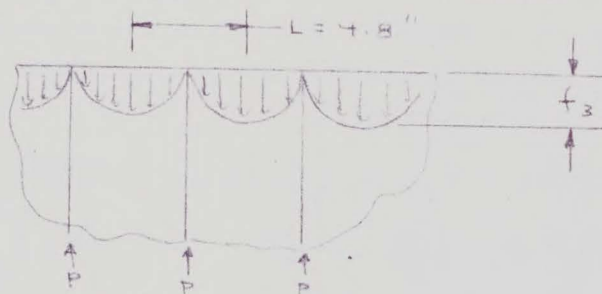
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THE MEMBRANE TENSION EFFECTS ON
EDGE MEMS -

- DUE TO MEMBRANE TENSION THE
DOOR EDGE MEMBERS WILL BE SUBJECT
TO A UNIFORM LOADING WHOSE DISTRIB-
UTION WILL BE ASSUMED AS PARABOLIC.
ON THE SHORT SIDE OF THE PANEL
THIS WILL RESULT IN AXIAL COMP.
IN FRAME SEGMENTS FORMING THE
DOOR TRANSVERSE STIFFENERS -



$$P = \frac{2}{3} \times 4.8 \times 6550 \times 0.032$$

$$= 672 \text{ * c}$$

THESE STIFFENERS WILL ALSO BE
SUBJECT TO A UNIFORM LOADING
EQUAL TO $5.5 \times 4.8 = 26.4 \text{ */m}$

THE FASTENERS ON THE EDGES
WILL BE LOADED TO -
 $6550 \times 0.032 = 210 \text{ */m}$

TOTAL LOAD / RIV. -

$$\sqrt{200^2 + 210^2} = 293 \text{ */m SHEAR}$$

NEGLECTING SLIGHT TENSION COMPONENT -
USE AN426-AD4 ALLOW = 210*
USING 5/8" SPACING -

$$M.S. = 336 / 293 - 1 = +.15$$

* MEMBRANE TENSION WITH PINNED EDGES

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

7-0556-62

SHEET NO.

2-7

AIRCRAFT:

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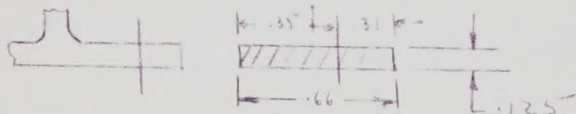
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CHECKING FOR BENDING @ FILLET
OF END CLEAT-

$$M = 45.3 \times 31 = 14.0 \text{ in.}$$

TAKING FLG. WIDTH = .35 + .31 = .66

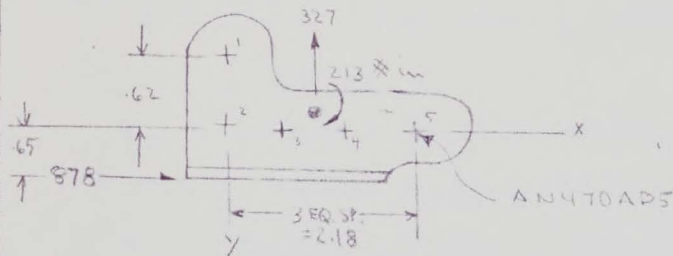


$$I = \frac{1}{12} \times .66 \times .125^3 = .00011 \text{ in}^4$$

$$f_b = \frac{14 \times 12}{2 \times 8 \times 11 \times 10^{-5}} = 8000 \text{ PSI}$$

$$M.S. = 72000 / 8000 - 1 = 8.0$$

CHECKING CLEAT RIV. LOADS AT
STIFFENER ATTACHMENT-



$$\Sigma M = 213 - 878 \times .77 = 464 \text{ in.}$$

$$P_x = 878 / 5 = 177 \rightarrow$$

$$P_y = 327 / 5 = 65 \uparrow$$

$$\Sigma y^2 = .62^2 = .382 \text{ in}^2$$

$$\Sigma x^2 = .72^2 + 1.4^2 + 2.18^2 = 7.126 \text{ in}^2$$

$$\bar{x} = 4.30 / 5 = .86 \text{ in}$$

$$\bar{y} = .62 / 5 = .124 \text{ in}$$

$$\bar{I}_x = .3820 - .075 = .307$$

$$\bar{I}_y = 7.126 - 3.70 = 3.426$$

$$I_p = \Sigma = 3.733$$

RIV.	P_{mx}	P_{my}	P_x	P_y	P
1	62.2	107.6	177	65	122
2	15.5	107.6			198
3	15.5	17.3			200
4	15.5	71.1			237
5	15.5	164.1	177	65	330

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

7-0356-62

SHEET NO.

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AIRCRAFT:

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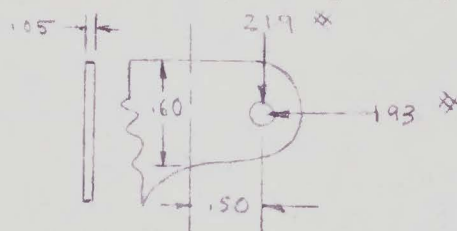
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USING AN470AD4 -

$$P_{ALLOW} = 385 \text{ K}$$

$$\text{E.I.M.S.} = 385 / 330 - 1 = +.16$$

CHECKING END OF CLEAT



$$M = 2.19 \times .5 = 1.10 \text{ in.}$$

$$f_c = 1.93 / .030 = 6430 \text{ PSI}$$

$$I = \frac{1}{12} \times 1.05 \times .60^3 = .00081$$

$$f_b = 1.10 \times .30 / .00081 = 40800 \text{ PSI}$$

TOTAL STRESS

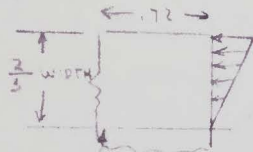
$$f_t = 40800 - 6430 = 33370$$

$$\text{E.I.M.S.} = 78000 / 33370 - 1 = +1.33$$

$$f_c = 40800 + 6430 = 47230 \text{ PSI}$$

$$\text{E.I.M.S.} = 70000 / 47230 - 1 = +.48$$

CHECKING STABILITY OF COMP. EDGE



CONSIDER
PINNED

CONSIDER AS "ENDS PINNED,
ONE SIDE FREE, ONE SIDE
PINNED".

$$a = 1.72$$

$$b = .40$$

$$a/b = 4.3$$

$$K = 1.7$$

$$t/b = .050$$

$$= .125$$

$$F_{cr} = K E (t/b)^2$$

$$= 1.7 \times 10.5 \times 10^6 \times .0156 = 215000 \text{ PSI}$$

USE COMP.
YIELD AS ABOVE

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TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT

C105

ACCESS DOOR
HYDRAULIC

W/S

REPORT NO.

7-0722-66

SHEET NO.

2 - 11

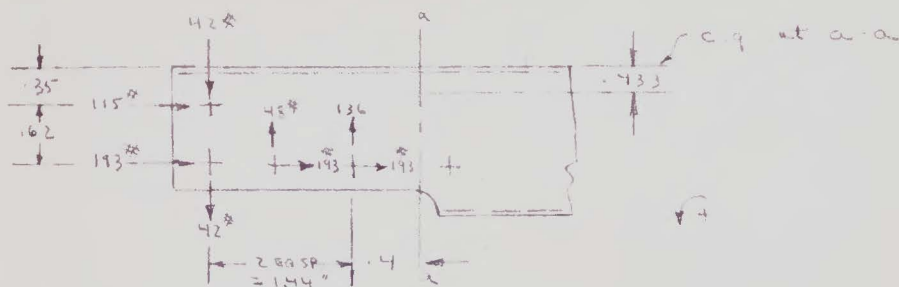
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LOCAL BENDING CHECK



$$\sum M_{a-a} =$$

$$= 193 \times 3 \times .54 + 24 \times 184 - 115 \times 108 - 48 \times 112 - 136 \times .4$$

$$= 351 \text{ lb-in}$$

$$f_b = \frac{351 \times .88}{.0151} = 20500 \text{ PSI C}$$

$$f_c = 878 / .0816 = 10750 \text{ PSI C}$$

$$\Sigma = 31250 \text{ PSI C}$$

$$F.M.S. = 64000 / 31250 - 1 = +1.05 \text{ SEE BELOW}$$

CHECKING CRIPPLING ON UNSUPPORTED
EDGE - @ a-a

ASSUME STABILIZED WITH PIN CONDITION
AT C.G. - THEN FOR 3 SIDES PINNED
1 SIDE FREE -

$$\left. \begin{array}{l} a = .40 \\ b = .88 \end{array} \right\} \frac{a}{b} = .455 \quad K = 3$$

$$F_{cr} = 3 \times 10.5 \times 10^6 \left(\frac{.040}{.88} \right)^2$$

$$* = 65000 \text{ PSI}$$

$$F.M.S. = 65000 / 31250 - 1 = +1.07$$

* COMP. YIELD GOVERN

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0556-62

SHEET NO. 2-13

AIRCRAFT:

C105

ACCESS DOOR
HYDRAULIC
C/S

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$$\therefore M_{MAX} = 264 \times 772 (1.06) = 1224 \text{ # in}$$

CONSIDERING BEAM AS COMPOSED OF
AXIAL + END COUPLES -

$$M_{MAX} = M \sec \frac{V}{2}$$

$$= -329 \times 1.06 = -350 \text{ # in}$$

$$\therefore \text{TOTAL } M_{MAX} = 1224 - 350$$

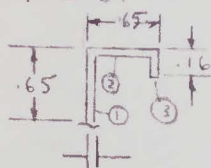
$$= +874 \text{ # in}$$

$$f_b = \frac{874 \times .92}{.06458} = 12400 \text{ PSI}$$

$$f_c = 878 / .1461 = 6000 \text{ PSI}$$

$$\therefore f_{TOTAL} = 18400 \text{ PSI}$$

CHECKING CRIPPLING ALLOW ON COMP.
FLG. -



ELEMENT	F_{CL}	$F_{CL} \times b$
1	70000	11200
2	70000	45500
3	26500	17200

$$\Sigma = 73900$$

$$F_{CULT} = 73900 / 1.46 = 50600 \text{ PSI (AV.)}$$

$$\therefore M.S. = 50600 / 18400 - 1 = +1.75$$

FOR TENSION FLG. -

$$f_t = 12400 - 6000 = 6400 \text{ #}$$

COMBINING WITH LOCAL RIV. BENDING

$$f_{tTOTAL} = (6400^2 + 30100^2)^{1/2} = 30700 \text{ PSI}$$

$$\& M.S. = 72000 / 30700 - 1 = +1.34$$

TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0336 62

SHEET No. 2 - 14

AIRCRAFT:

C 105

ACCESS DOOR
HYDRAULIC
C/S

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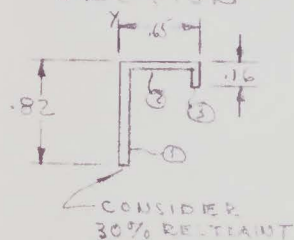
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CHECKING FOR COLUMN STABILITY -

THE BEAM WILL BE CONSIDERED TO BE STABLE SO LONG AS THE UPPER PORTION OF CROSS SECTION CAN RESIST THE APPLIED LOADS -

USING FOLLOWING EFFECTIVE CROSS SECTION -



ELEMENT	A	X	Ax	Ax ²	I _{oy}
1	.0328	.020	.00066	.00001	—
2	.0228	.325	.00742	.00241	.00062
3	.0064	.610	.00390	.00238	—
Σ	.0620		.01198	.00480	.00062

$$\bar{X} = .01198 / .0620 = .193$$

$$\bar{I}_{ox} = .00542 - .01198 \times .193 = .00311$$

$$\rho = \sqrt{\frac{.00311}{.0620}} = .225$$

$$L/\rho = 24.75 / .225 = 110$$

CALC. AV. CRIPPLING ALLOW -

ITEM	D/t	F _{cc}	F _{cc} x b
1	.82	27500*	22500
2	.65	70000	45500
3	.16	70000	17200

$$\Sigma = 163 \quad \Sigma = 85200$$

$$F_{cc \text{ ACT}} = 85200 / 1.63 = 52000 \text{ PSI}$$

USING JOHNSON-EULER CURVE - BROW P. 17
FOR C = 1 & f = 52000 P_{allow} = 9090 PSI

WITH f_b TOTAL = 12400

$$M.S. = 9090 / 12400 = .73$$

* INTERPOLATED FOR 30% FIXITY

SEE P. 12

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DUE TO FOREGOING NEC MARGIN BATTENS
WILL BE USED TO STABILIZE THE
INB'D (COMP.) FLG. THE BATTENS
WILL BE SPACED TO DIVIDE THE
UNSUPPORTED FLG. INTO THIRDS -
CONSIDERING BATTENS ACTING
IN PAIRS - FOR OVERALL COLUMN EFFECT

$$P_{cr} = \frac{\pi^2 EI}{L^2} \times \frac{1}{1 + \frac{\pi^2 EI}{L^2} \left(\frac{ab}{12EI_b} + \frac{a^2}{24EI_c} \right)}$$

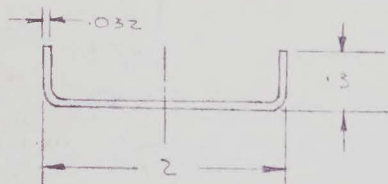
WHERE

$$I_c = .00311 \quad \text{SEE P 13}$$

$$I = 2I_c + \frac{Ac b^2}{2} = 2 \times .00311 + \frac{.0620 \times 4.8^2}{2}$$

$$= .721 \text{ in}^4$$

CONSIDERING BATTENS -



$$I_b = \frac{1}{12} \times 0.032 \times 19.36^3 + (3 \times 0.032 \times 4.84) \times 2$$

$$= .01925 + .01920$$

$$= .03845 \text{ in}^4$$

$$a = 25.50 / 3 = 8.50$$

$$b = 4.8$$

$$L = 25.50$$

$$\frac{\pi^2 EI}{L^2} = \frac{\pi^2 \times 10.5 \times 10^6 \times .721}{25.50^2} = 115000$$

$$\frac{ab}{12EI_b} + \frac{a^2}{24EI_c} = \frac{8.50 \times 4.8}{12 \times 10.5 \times 10^6 \times .03845} + \frac{8.50^2}{24 \times 10.5 \times 10^6 \times .00311}$$

$$= 8.4 \times 10^{-6} + 92 \times 10^{-6}$$

$$= 100.4 \times 10^{-6}$$

* SEE P 145 "ELASTIC STABILITY" TIMOSHENKO

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TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-4526-62

SHEET NO. 2-10

AIRCRAFT:

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ACCESS DOOR
HYDRAULIC

9/5

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$$P_{cr} = 115000 \frac{1}{1 + 115000 (1004 \times 10^{-6})}$$

$$= 9200 \text{ K}$$

$$\& P_c \text{ ACTUAL} = 15400 \times 0.620 \times 2 = 2300 \text{ K}$$

$$\therefore \text{M.S.} = 9200 / 2300 - 1 = +3.0$$

THE ABOVE MARGIN IS HARDLY MORE THAN AN INDICATION OF COLUMN STRENGTH. IT MERELY INDICATES THAT AS A LATTICED COLUMN THE STIFFERS ARE STABLE.

CHECKING UPPER FLANGE AS PINNED COLUMN B/T BATTENS -

C = 2 ASSUMED (SEE PINNED ELASTIC STABILITY "TIMO.")

$$\frac{L}{r} = 36$$

USING MODIFIED EULER EQ - (PARABOLIC)

$$f_c = 52000 - \frac{52000^2 (36^2)}{4 \times 1 \times \pi^2 \times 105 \times 10^6 \times 2}$$

$$= 52000 - \frac{7750}{2} = 48125 \text{ PSI}$$

$$\& \text{M.S.} = 48125 / 18400 - 1 = +1.61$$

* CRIPPLING ALLOW.

TECHNICAL DEPARTMENT (Aircraft)

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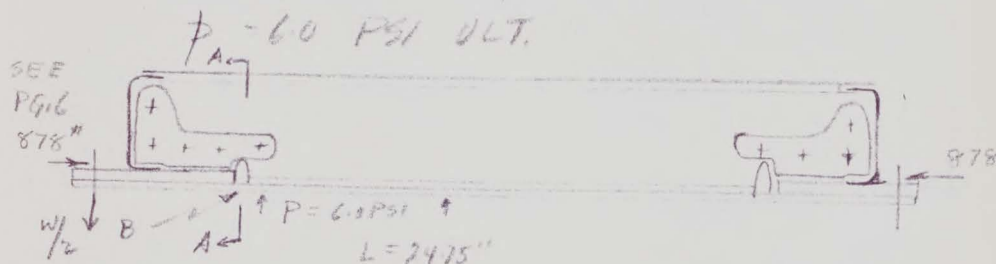
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CHECK TRANSVERSE STIFFENERS FOR MISSILE
BLAST PRESSURE CASE



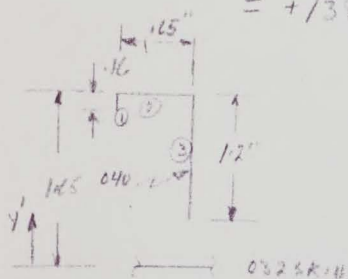
$$\frac{W}{2} = \frac{60 \times 4.8 \times 24.75}{2} = 356 \text{ \#}$$

AT SECTION A-A, POINT B

$$P = 878 \text{ \# COMP}$$

$$BM = +878 \times (.032 + .125) + \frac{60 \text{ PSI} \times 4.8 \times 3.2^2}{2} - 356 \times 3.2$$

$$= +138 + 147 - 1130 = -845 \text{ \# \#}$$



ITEM	A	y'	Ay'	Ay'^2	I_0
1	.0048	1.57	.0076	.0121	—
2	.0260	1.6	.0416	.0665	—
3	.0480	1.05	.0504	.0529	.0057
SKIN	.0307	0	0	0	—
Σ	.1095	.91	.0996	.1315	.0057

$$I = .1315 + .0057 - .1095 \times .91^2 = .1281$$

$$SKIN \ y_c = .91$$

TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0550 62

SHEET No. 2-18

AIRCRAFT:

C105

HYDRAULIC
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AT CENTROID OF SECTION A-A

$$P = 878 \text{ " COMP}$$

$$BM = -845 \text{ " " } - 878 \times .91 = 1645 \text{ " "}$$

$$SKIN \quad f_c = \frac{1645 \times .91}{.1281} + \frac{878}{.1095}$$

$$= 11700 + 7940 = 19,640 \text{ PSI COMP}$$

ALLOW INTER RIVET BUCKLING STRESS

$$t/l = \frac{.190}{1032} = 28.2$$

$$F_{ir} = 37000 \text{ PSI}$$

$$MS = \frac{.92 E \times 37000}{19640} - 1$$

173

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TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

7-0556-62

SHEET NO.

2-21

AIRCRAFT:

C105

ACCESS DOOR
HYDRAULIC
C/S

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AT TRANSVERSE EDGE D'BIR -
THE STRUCTURAL ADEQUACY OF
THE DOOR WILL BE DETERMINED
BY THE ABILITY OF THE D'BIR TO
TRANSMIT 18.8 K/W. IN BENDING
& A MEDIAN STRESS (MEMBRANE)
OF 8880 PSI (SEE P 2) PLUS SKIN
TENSION

$$I/w = \frac{1}{12} \times 1 \times .072^3 = 30 \times 10^{-6}$$

$$\therefore f_b = \frac{18.8 \times 112^* \times .072}{2 \times 30 \times 10^{-6}} \\ = 27000 \text{ PSI}$$

MEMBRANE TENSION -

$$9880 \times .032 / .072 = 4400 \text{ PSI}$$

$$\therefore \Sigma f = 31400 \text{ PSI}$$

$$\& \text{M.S.} = 72000 / 31400 - 1 = +1.3$$

FASTENER CHECK -

AT TRANSVERSE EDGE - CRITICAL
CAMLOCKS @ APPROX 2.5" C-C -

$$P_{\text{DIRECT}} = 2.5 \times 18.8 = 47 \text{ K TENSION}$$

$$P_{\text{SHEAR}} = 2.5 \times 200 = 500 \text{ K SHEAR} \uparrow$$

$$P' = 2.5 \times .032 \times 9880 = 800 \text{ K SHEAR} \leftarrow$$

$$\& \Sigma \text{SHEAR} = (500^2 + 800^2)^{\frac{1}{2}} = 945 \text{ K}$$

$$P_{\text{ALLOW FOR CAMLOCKS}} = 500 \text{ K}$$

\therefore SPACE SCREWS B/T CAMLOCKS OR
USE CAMLOCKS @ $2.40 / 2 = 1.20"$

$$\& \text{M.S.} = 500 / 472 - 1 = +1.06$$

* DIST FROM RIV. TO FASTENER

* BASED ON DEF.

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TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

7-0556 64

SHEET NO.

2-22

AIRCRAFT:

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CHECKING D'B.R. FOR BENDING AT BASE
OF CLERAT - NOTE $\rightarrow$ Change ^{also} up if number
now 3rd 14

$$M_0 = 225 \times 1 = 225 \text{ ft-lb}$$

$$\text{FOR EFFECTIVE WIDTH} = \frac{3}{8} \times 2.40 = 1.6$$

$$I = 101 \times 10^{-6} \text{ (}.091 \text{ D'B.R.)}$$

$$\therefore f_b = \frac{225 \times .091}{2 \times .0001} = 102000 \text{ PSI}$$

$$f_{b \text{ allow}} = 1.5 \times 72000 = 108000 \text{ PSI}$$

$$\% \text{ M.S.} = 108000 / 102000 - 1 = +.06 \quad \leftarrow$$

CHECKING AREA AS WIDE BEAM
PER P 123 "FORMULAS FOR STRESS
& STRAIN" ROARK -

$$\begin{aligned} \text{MAX } S &= \frac{3.05 P}{t^2} \\ &= \frac{3.05 \times 225}{.091^2} = 80000 \text{ PSI} \end{aligned}$$

$$\% \text{ M.S.} = 108000 / 80000 - 1 = +.35 \quad \leftarrow$$

IT WOULD APPEAR THAT THE TRUE
M.S. WOULD LIE B/T ABOVE TWO
EXTREMES

* SEE P 5 REPORT

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-2200 (L)

SHEET NO. 2-24

AIRCRAFT:

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$$\frac{T}{12} = \frac{16^3}{12} = \frac{1 \times .032^3}{12} = \frac{2.73}{10^6}$$

$$\delta = \frac{5}{384} \frac{26.4 \times 4.8^3}{10^7 \times \frac{2.73}{10^6}} = 1.385''$$

(2) CONSIDER 100% OF LOAD CARRIED BY
MEMBRANE ACTION TO DOOR EDGE MEMBERS



FROM R&M 2094

$$\delta^3 = \frac{3}{64} \frac{pL^4}{Et} \quad \text{FOR 1" STRIP}$$

$$\delta^3 = \frac{3}{64} \frac{5.5 \times 25^4}{10^7 \times .032} = .316$$

$$\delta = .68''$$

COMBINING BOTH LOAD PATHS AND TRIAL &
ERROR CALCULATIONS,

$$\delta = .57''$$

PLATE (BENDING) ACTION, $p_p = 2265$ PSI

MEMBRANE (TENSURE) ACTION, $p_m = 3.235$ PSI

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0556-88

SHEET NO. 2-26

AIRCRAFT:

C105

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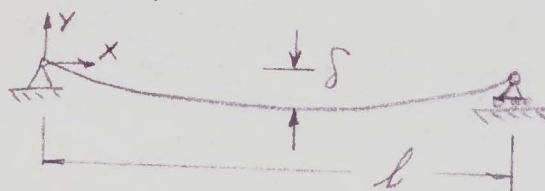
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REFERENCE: THEORY OF ELASTIC STABILITY
- TIMOSHENKO PG. 28



SHORTENING OF THE DEFLECTED CURVE

$$\lambda = \frac{1}{2} \int_0^l \left(\frac{dy}{dx} \right)^2 dx$$

ASSUME A SINE CURVE DEFLECTED
SHAPE, $y = \delta \sin \frac{\pi x}{l}$

$$\begin{aligned} y &= 0 & x &= 0, l \\ y &= \delta & x &= \frac{l}{2} \end{aligned}$$

$$y' = \frac{\pi \delta}{l} \cos \frac{\pi x}{l}$$

$$\lambda = \frac{1}{2} \int_0^l \left(\frac{\pi \delta}{l} \cos \frac{\pi x}{l} \right)^2 dx = \frac{\pi^2 \delta^2}{2l^2} \int_0^l \cos^2 \frac{\pi x}{l} dx$$

$$\text{AND } \int \cos^2 ax \cdot dx = \frac{x}{2a} + \frac{\sin 2ax}{4a}$$

$$\lambda = \frac{\pi^2 \delta^2}{2l^2} \left[\frac{\pi x}{2\pi} + \frac{\sin 2\pi x/l}{4\pi/l} \right]_0^l = \frac{\pi^2 \delta^2}{2l^2} \left[\frac{l}{2} \right]$$

$$\lambda = \frac{\pi^2 \delta^2}{4l}$$

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MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:

C105

HYDRAULICS
ACCESS
DOOR

REPORT No. 7-6556-66

SHEET No. 2-29

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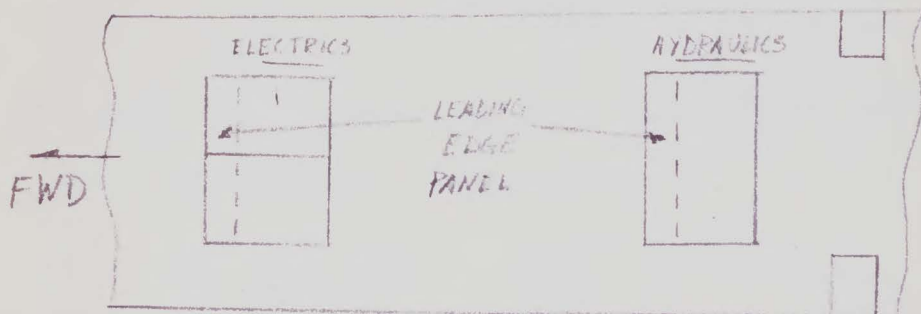
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RECALCULATE DOOR 'GAPPING' WITH LIMIT
LOADS.



BOTTOM SKIN SUCTIONS ARE CONSERVATIVE SINCE
THE DOORS ARE BETWEEN THE DIVE BRAKES
AND NOT IN A FORE & AFT LINE WITH THEM.

AERO MEMO 4643/20/J, SEPT 13/54
QUOTES 430 P.S.F. AT ELECTRICS DOOR &
375 P.S.F. AT HYDRAULICS DOOR FOR SEA
LEVEL, $M=1.95$ CASE.

THE SKIN TENSION STRESS AT ELECTRICS
DOOR IS 10000 PSI & AT HYDRAULICS DOOR
IS 20000 PSI FROM L. GOULD.

THE L.E. PANELS ARE 4.9×13.25 (ELECTRICS) & 4.8×25
(HYDRAULICS).

BY INSPECTION, THE HYDRAULICS DOOR IS
CRITICAL.

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0550-62

SHEET NO. 2-36

AIRCRAFT:

C105

HYDRAULICS
ACCESS
DOOR

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HYDRAULICS DOOR

375 P.S.F. LIMIT SUCTION

$$\text{ie } \frac{375}{144} = 2.6 \text{ PSI}$$

① 100% OF LOAD CARRIED BY BEAM BENDING ACTION BETWEEN FORMERS

$$\delta_b = \frac{5}{384} \frac{WL^3}{EI} = \frac{2.6 \text{ PSI}}{557 \text{ PSI}} \times 1.385 = 0.655''$$

② 100% OF LOAD CARRIED BY MEMBRANE ACTION TO DOOR EDGE MEMBERS.

$$\delta^3 = \frac{3}{64} \frac{pL^4}{Et} = \frac{2.6 \times 1316}{5.5} = .1492$$

$$\delta = .53''$$

COMBINING BOTH LOAD PATHS AND TRIAL & ERROR CALCULATIONS

$$\delta = .391''$$

PLATE (BENDING) ACTION, $p_p = 1.55 \text{ PSI}$

MEMBRANE (TENSION) ACTION, $p_m = 1.05 \text{ PSI}$

TECHNICAL DEPARTMENT (Aircraft)

REPORT No. 7-0530-62

SHEET No. 2-31

AIRCRAFT:

C105

HYDRAULIC
ACCESS
DOOR

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DOOR 'GAPPING'

$$\Delta l = \frac{\pi^2 f^2}{4L} = \frac{\pi^2 \cdot 391^2}{4 \times 418} = .078''$$

UNDER SKIN TENSION OF 20,000 PSI

$$\Delta l = \frac{f}{E} l = \frac{20000}{10^7} \times 19.2'' = .0384$$

$$\Delta l = .116''$$

THE SEATING OF THE DOOR ON THE FORMER
EDGE MEMBER LIP IS

0.24" NOMINAL

0.20" ADVERSE TOLERANCES

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0556-62

SHEET NO. 2-32

AIRCRAFT:

C105

HYDRAULIC
ACCESS
DOOR

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ELECTRICAL DOOR

① 100% PLATE

$$p = \frac{430}{144} = 2.99 \text{ PSI}$$

$$\delta = \frac{2.99 \times 13.85}{5.5} = 0.754''$$

② 100% MEMBRANE

$$\delta = \frac{3}{64} \frac{p l^4}{E t} = \frac{3}{64} \frac{2.99 \times 13.25^4}{10^7 \times 0.032} = 0.01355$$

$$\delta = 0.238''$$

BY TRIAL & ERROR, $\delta = 0.212$

$$p_p = 0.84 \text{ PSI}$$

$$p_m = 2.15 \text{ PSI}$$

DUE TO PRESSURE $\Delta l = \frac{\pi^2 \times 0.212^2}{4 \times 4.8} = 0.0231$

DUE TO SKIN TENSION $\Delta l = \frac{100 \times 10 \text{ PSI}}{10^7} \times 19.7 = 0.0197''$

$$0.0 \Delta l = 0.0428''$$

AIRCRAFT:

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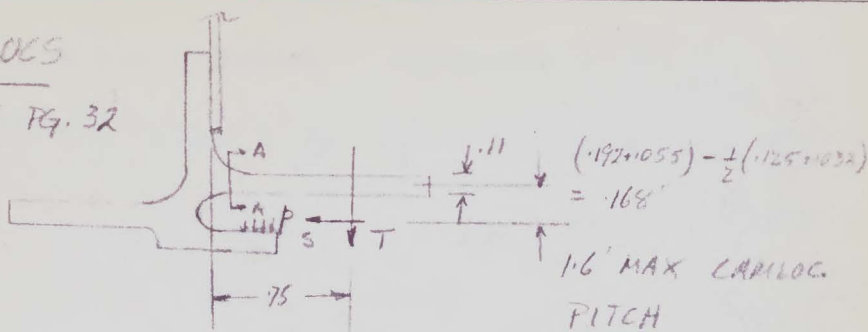
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CAM LOCKS

SEE PG. 32



AT A-A

CONSIDER $f_b = 40,000 \text{ PSI}$

$$\frac{I}{c} = \frac{bt^3}{6} = \frac{1.6 \times 11^3}{6}$$

$$A_1 = .75 T + .168 S$$

$$f = \frac{M}{T/c} \quad 40000 = \frac{M}{16 \times 11^2}$$

$$M = \frac{40000 \times 1.6 \times 11^2}{6} = 129 \text{ " " ALLOW}$$

THE HYDRAULIC ACCESS DOOR WAS CHECKED TO

CANLOC SHEAR = $\left(200 \frac{\text{#}}{\text{IN}} \text{ SHEAR} \rightarrow 210 \frac{\text{#}}{\text{IN}} \text{ MEMBRANE TENSION} \right) 1.6 \text{ PITCH} = 468$

$$TENSAN = \frac{1.6 \text{ PITCH}}{1.2 \text{ PITCH}} \times 47 = 63$$

DESIGN $M = .75 \times 63 + .168 \times 468 = 116$

HENCE ACTUAL STRESS = $\frac{116}{129} \times 40000 = 36,000 \text{ PSI}$

AIRCRAFT:

C105

HYDRAULICS
ACCESS
DOOR

BEAM ACTION BEARING PRESSURE, p

$$\text{LOADING/"SPAN} = \frac{P}{L} \cdot \frac{4.8}{2} = 2.265 \times 2.4 = 5.44 \text{ #/"}.$$

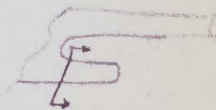
$$P = \frac{5.44}{.20 \text{ LIP WIDTH}} = 27.2 \text{ PSI} \quad - \text{LOW}$$

(ADVERSE TOLERANCE)

$$\text{LIP BM} = 5.44 \frac{\text{ft}}{\text{SPAN}} \times .28 = 1.52 \frac{\text{ft}}{\text{ft}}$$

$$\frac{I}{C} = \frac{\delta t^2}{6} = \frac{1'' \cdot 07^2}{6} = \frac{.0049}{1}$$

$$f_b = \frac{1.52}{\frac{0.049}{6}} = 1870 \text{ PSI} - \text{LOW}$$



WITH NO CAMLOCS FASTENED ON DOOR L.E.,
LOAD / CAMLOC ON DOOR EDGE MEMBERS

$\rho = 3.235 \text{ P.S.I.}$ $\delta = .57$

$$\frac{f}{t} = \frac{p l^2}{8 t \delta} = \frac{3.235 \times 25^2}{8 \times 0.32 \times 57} = 13,900 \text{ PSI}$$

$$T = 13920 \cdot 0.32 = 445.44^\circ \text{C}$$

LOAD/CAM LAG = $445 \frac{\text{lb}}{\text{in}} \times 16 \text{ in MAX PITCH} = 710 \frac{\text{lb}}{\text{in}}$ # MEMBRANE TENSION

THERE IS AN ADDITIONAL BOTTOM SKIN SHEAR
LOAD ON THE DOOR CAMLOCKS.

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:

C105

HYDRAULIC
ACCESS
DOOR

REPORT NO.

2-0336-6L

SHEET NO.

2-35

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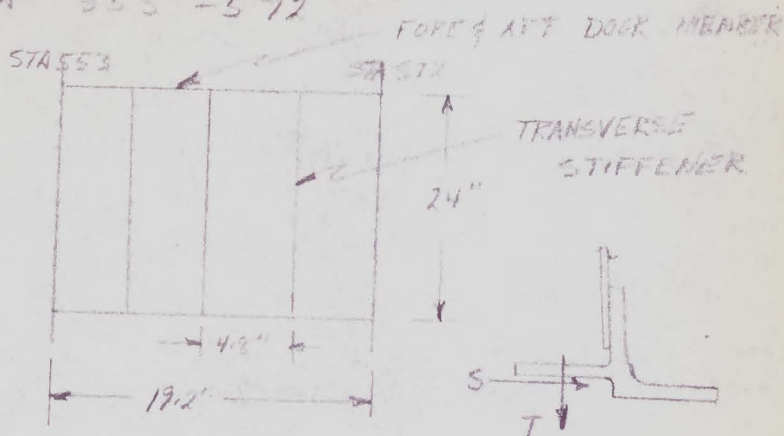
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CANLOCS ON FORE & AFT MEMBER SPANNING

STA 553 - 572



FORMER 553

$$\text{SHEAR / CANLOC} = \frac{1}{4} \left(\frac{200}{16} \right) \text{ DOOR SHEAR} \rightarrow \frac{209}{16} \text{ / MEMBRANE ACTION}$$

$$= 468 \text{ PSI} \quad \text{PG 26}$$

$$\text{TENSION / CANLOC} = 5.5 \text{ PSI} \times \frac{4.8}{2} \times 16 \text{ PITCH} = 18.5 \text{ PSI}$$

SEE PG 26

$$\therefore M = .75 \times 18.5 + .168 \times 468 = 13.8 + 78.8 = 92.6$$

$$\therefore f_b = \frac{92.6}{\frac{1.6 \times .11^2}{6}} = 28,700 \text{ PSI}$$

FORE & AFT DOOR MEMBER

$$\text{SHEAR / CANLOC} = \frac{200}{16} \times 16 = 320 \text{ PSI}$$

MEMBRANE ACTION NEGLIGIBLE.

CONSIDER TRANSVERSE STIFFENER LOAD TAKEN
BY THREE CANLOCS

$$\text{TENSION / CANLOC} = 5.5 \text{ PSI} \times 4.8 \times \frac{24}{2} \times \frac{1}{3 \text{ CANLOCS}} = 106 \text{ PSI}$$

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MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

AIRCRAFT:

C105

HYDRAULIC
ACCESS
DOOR

REPORT NO.

7-0556-12

SHEET NO.

2-55

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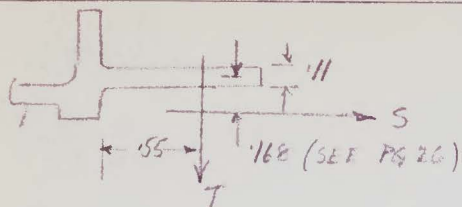
DATE

S. YOUNG

6/7 28/55

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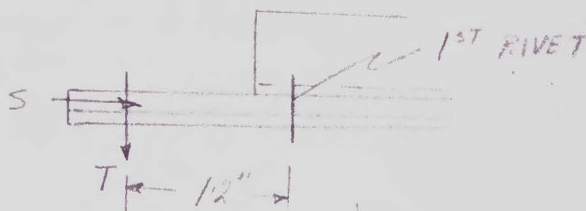
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$$M = 1.68 \times 320 + 1.55 \times 106 = 53.8 + 58.3 = 112.1$$

$$f_b = \frac{112.1}{\frac{1.6 \times 1.11^2}{6}} = 34,800 \text{ PSI}$$

DOOR DOUBLER BENDING



$$M = 1.2 \times 106 = 127$$

$$I/c = \frac{1.6 \times 1.25^2}{6} + \frac{1.6 \times 0.32^2}{6} = 0.0417 + 0.0027 = 0.0444$$

$$f_b = \frac{127}{0.0444} = 28,600 \text{ PSI}$$

THE DOOR EDGE MEMBER BENDING STRESSES
WERE CHOSEN LESS THAN 40,000 PSI FOR
FATIGUE REASONS.

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-2556-62

SHEET NO. 2-37

AIRCRAFT:

C105

HYDRAULIC
ACCESS DOOR

PREPARED BY

DATE

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FROM REPORT

BOTTOM SKIN TENSION

LOADING

FORMER 553

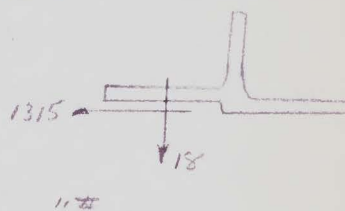
FOR 20 000 PSI TENSION IN SKIN

$$\text{LOAD / CAMLOC} = (20000 \times 0.032\% + 181\% \text{ MEMBRANE TENSION}) / 1.6'' \text{ PITCH} = 1315''$$

$$\text{CAMLOC TENSION} = 18''$$

$$\frac{P}{A} = \frac{1315}{1.6 \times 11} = 7450 \text{ PSI}$$

$$\text{BM} = -75 \times 18 + 168 \times 1315 = 207''$$



$$\text{PLASTIC BENDING } f_b = \frac{1}{1.5} \frac{207}{1.6 \times 11^2} = 42800 \text{ PSI}$$

NEGLECTING BOLT
CLAMPING ACTION

$$\text{MS} = \frac{.73 \times 75000 F_{TUT} - 1}{42800}$$

.08

CAMLOC BEARING PRESSURE CAMLOC DIA = $\frac{3}{8}''$

$$\frac{P}{A} = \frac{1315}{\frac{3}{8} \times 11} = 31800 \text{ PSI}$$

CONSIDER A POINT OF INFLECTION IN CAMLOC PIN

$$\text{SUCH THAT PIN BM} = \frac{207}{2} = 104''$$

$$\text{PLASTIC BENDING } f_b = \frac{1}{1.5} \frac{104}{\frac{3}{8} \times 11^2} = 91600 \text{ PSI}$$



$$\text{MAX. BEARING PRESSURE } f_{br} = 91600 + 31800 = 123400 \text{ PSI}$$

$$F_{BR0} = 133000 \text{ PSI 'B' VALUE 755T EXTRUSION}$$

$$\text{MS} = \frac{133000}{123400} - 1$$

.08

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO. 7-0556-62

SHEET NO. 2-38

AIRCRAFT:

C105

HYDRAULIC
ACCESS DOOR

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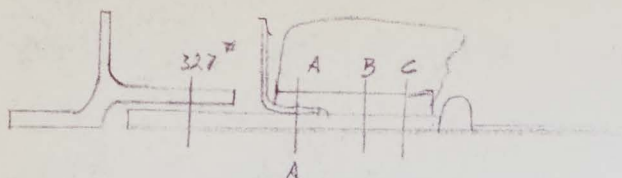
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$$BM_{A-A} = 327 \times 1.35 = 442 \text{ " #}$$

USE 2" WIDTH OF 125 DOUBLER & .032 SKIN

$$\frac{I}{C} = \frac{bt^2}{6} = \frac{2 \times .157^2}{6} = .00821$$

$$f_b = \frac{442}{.00821} = 53,800 \text{ PSI}$$

$$F_u = 100,000 \times .73 = 51,100 \text{ PSI}$$

$$\text{ELASTIC BENDING, MS} = \frac{51,100}{53,800} - 1 = -.05$$

WITH 1.5 FORM FACTOR

$$f_b = \frac{53,800}{1.5} = 35,800 \text{ PSI}$$

$$\text{PLASTIC BENDING M.S.} = \frac{51,100}{35,800} - 1 = .42$$

LOADS ON JO BOLTS A, C DIRECT LOAD = $\frac{327}{6} = 55 \text{ #}$

ABOUT B; B.M. = $327 \times 2.1 = 687 \text{ " #}$

$$\text{LOAD A \& C} = \frac{687}{1.43} = 480 \text{ #} \quad \therefore \text{BOLT LOAD} = 55 + \frac{480}{2} = 295 \text{ #}$$

ALLOW TENSION FOR 5/8 JO BOLT NOT AVAILABLE BUT CONSIDERED ADEQUATE. 5/8 HUCK IN TENSION IS 850 # ALLOW.

A. V. ROE CANADA LIMITED
MALTON - ONTARIO

TECHNICAL DEPARTMENT (Aircraft)

REPORT NO.

7-0550-12

SHEET NO.

2-90

AIRCRAFT:

C105

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B.M. = 100 " #

EFFECTIVE t OF 0.40 CHANNEL & 0.115 CLEAT

$$\sqrt{0.40^2 + 0.115^2} = .121$$

$$f_b = \frac{100}{\frac{.7 \times .121^2}{6}} = 58,600 \text{ PSI}$$

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

REPORT NO. 7-0552 62
SHEET NO. 2 42

AIRCRAFT:

CNE

HYDRAULIC
ACCESS DOOR

PREPARED BY

DATE

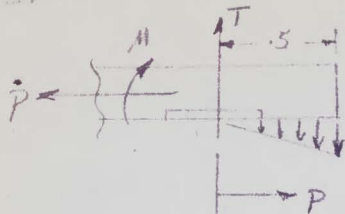
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CONSIDER NOW BOLT CLAMPING ACTION



ALLOW CLAMPING MOMENT
IS DEPENDENT ON
BENDING OF THE EXTRUSION
BETWEEN CAMLOC'S (1.6").

$$\text{ALLOW. CLAMPING } M = f_b \frac{I}{c}$$

$$\frac{I}{c} = \frac{1.6 \times 1.6^2}{6} = .0071$$

$$= 70000 \times .0071 = 497 \text{ "H RT}$$

ASSUME 50% BOLT CLAMPING, ie $M = 250 \text{ "H}$

ASSUME $P = 1900 \text{ "H}$ PER CAMLOC

$$\therefore \text{ OFFSET } M = 176.1940 = 375 \text{ "H}$$

$$\text{BOLT CLAMPING } M = 250 \text{ "H}$$

$$\text{BRG. PRESSURE } BAI = 85 \text{ "H}$$

$$P = \frac{1900}{.049} + \frac{85}{.00162} = 38800 + 80000 = 118800 \text{ "H}$$

~ 125000 FBRU

$$\therefore \text{ ALLOW CAMLOC LOAD } = 1900 \text{ "H R.T.}$$

$$1380 \text{ "H } 250 \text{ "H}$$

$$\text{PG. 35 MAX LOAD } P = 1315 \text{ "H}$$

$$MIS = \frac{1380}{1315} - 1$$

SNAP-LOCK BINDER, 1½ inch capacity

NO. 4872-W

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THE CHAS. CHAPMAN CO. LIMITED
London - Canada