FATIGUE

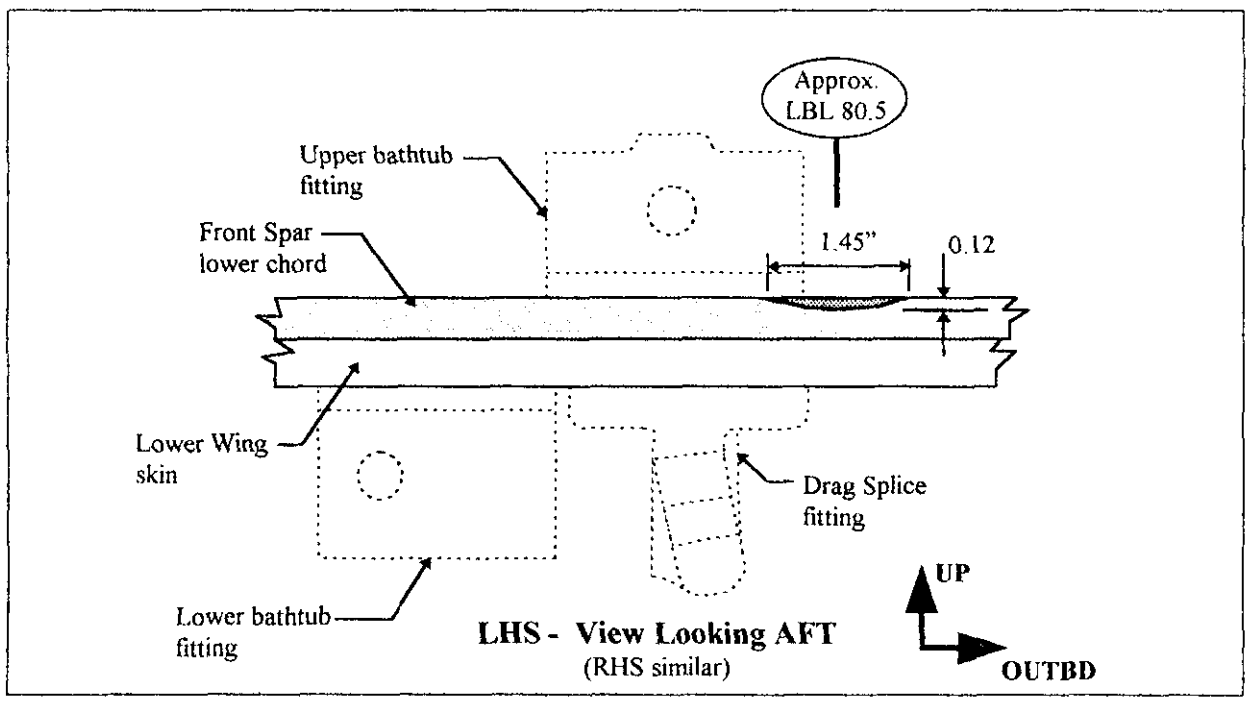
Front Spar lower horizontal chord - existing fatigue cracking

Fatigue cracks were found in the Front Spar lower horizontal chord in the fillet radius just outboard of the Drag Splice fittings at RBL/LBL 80. The existing cracks were approximately 1.2 inch and 1.45 inch on the RHS and LHS, respectively. The cracks originated at the inside fillet radius and were part through cracks, progressing approximately one third through the chord thickness (approximately 0.10 inch deep and 0.125 inch deep on the RHS and LHS, respectively).

The lower horizontal chord in the vicinity of the fatigue cracking is subjected to inspection under the Supplemental Structural Inspection Document (SSID) program. A previous instance of cracking at this location was found on a different 747-100. Those cracks were longer than those on TWA800 but also did not extend through the thickness of the chord. This region is affected by SB 747-53-2064 for adjacent ring chord cracking. The modification per SB 747-53-2064 had been installed in 1982, installing two bathtub fittings on the Wing Center Section lower skin panel and a double bathtub fitting on the fuselage skin. These fittings are immediately adjacent to the drag splice fitting and serve to provide an alternate load path for the drag splice forward/aft loads. It is apparent from the bathtub fitting arrangement that the post-modification configuration is very stiff and the deflection that would have initiated the fatigue cracking has been significantly limited. Without continued deflection, the fatigue growth cannot continue, indicating that the fatigue cracking existed prior to the installation of the bathtub fittings.

Visual examination of the ductile rupture surfaces adjacent to the relatively short, shallow cracks did not reveal any indication of wear. This is indicative of the gross fracture precipitating from something other than the fatigue cracking. The NTSB Materials Laboratory has examined the larger of the two fatigue cracks and will issue a separate report.

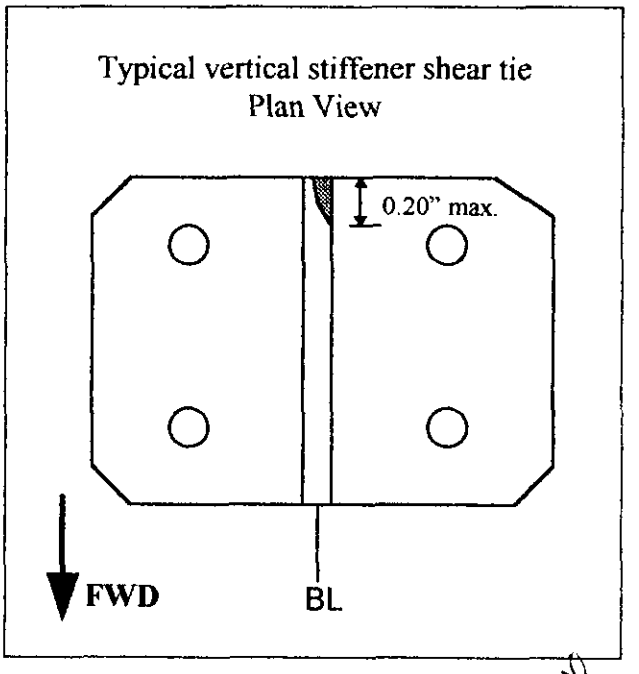
See the Metallurgical Field Notes for a complete cracking description.



Front Spar vertical stiffener shear ties - existing fatigue cracking

Small existing fatigue cracks were found in the vertical stiffener shear ties at RBL 83.24 (lower), RBL 75.92 (upper and lower), LBL 75.92 (upper and lower), and LBL 83.24 (lower). The cracks were all in the shear tie radius near the base of the leg that attaches to the vertical stiffener at the aft edge. This cracking is the subject of SB 747-57-2249. The Service Bulletin was issued in 1989 after reports of in-service cracking. The maximum crack length on the subject airplane was 0.20 inch long. In service, operators have reported cracks ranging from 0.50 inch to 1.5 inch long without complete part fracture, demonstrating the capability of these shear ties to withstand cracking in excess of the 0.20 inch detected cracking under normal operating conditions.

See the Metallurgical Field Notes for a complete cracking description.



1/24/97

1/24/97

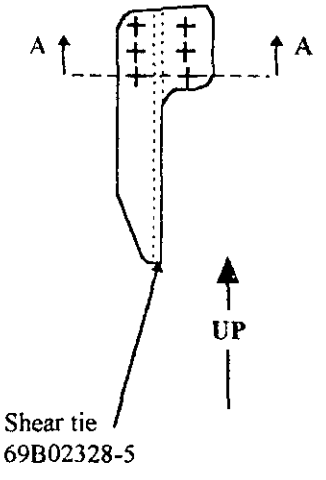
Longitudinal Floorbeam at Front Spar - existing fatigue cracking

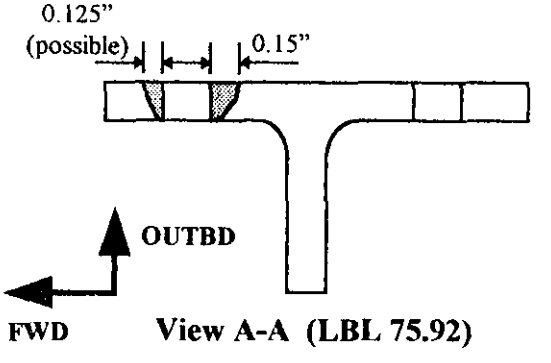
Small cracks were found in the shear tie of the LBL 75.92 and the LBL 33.99 longitudinal floorbeams at the intersection with the Front Spar upper chord at STA 1000. The LBL 75.92 shear tie has a 0.15 inch fatigue crack emanating from the aft side of the hole and a possible 0.125 inch fatigue crack emanating from the forward side of the hole as shown. The LBL 33.99 shear tie has a 0.25 inch fatigue crack emanating from the forward side of the hole.

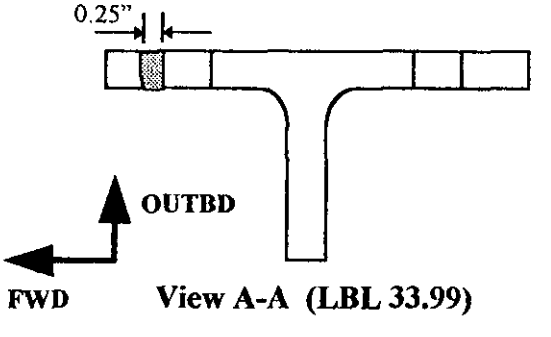
The component is a secondary attachment for floor structure and does not contribute to carrying primary operating loads.

See the Metallurgical Field Notes for a complete cracking description.

Longitudinal Floorbeam shear tie







JEWII 1/24/97

QTMD - Boeing 1/24/97

Front Spar areas with apparent fatigue cracks

*LH. ON 12/12/96 LOUISE HEATHCOTE - TWA

A RH Upper Wing Terminal Fitting approx. 2 inch below upper wing skin. ~~Crack initiated from~~ INBD Side. *L.H. ~~Crack dimensions ≈ 0.6" long x ≈ 0.1" deep~~. Mechanical ~~damage~~ damage. JE 12/4/96

B Upper Chord to Stiffener Shear Tie at RBL 75.92. Crack initiated at AFT/OUTBD Corner. Crack dimensions ≈ 0.1" x 0.2". JE 12/4/96 LH.

C Upper Chord to Stiffener Shear Tie at LBL 75.92. Crack initiated at AFT/OUTBD Corner. Crack dimensions ≈ 0.15" x ≈ 0.20". JE 12/4/96 LH.

D Floor beam to Upper Wing Skin Shear Tie at LBL 75.92. Crack initiated at fastener hole common to floor beam web. JE 12/4/96 LH.

E Lower Chord to Stiffener Shear Tie at RBL 83.24. Crack initiated at AFT/INBD Corner. Crack dimensions ≈ 0.1" x ≈ 0.2". JE LH

F Lower Chord at ≈ RBL 80.5. Crack initiated at upper surface from multiple origins in the extruded radius. Crack dimension ≈ 1.2" long x ≈ 0.1" deep. JE

G Lower chord at ≈ LBL 80.5. Crack initiated at upper surface from multiple origins in the extruded radius. Crack dimensions ≈ 1.45" long x ≈ 0.125" deep. JE

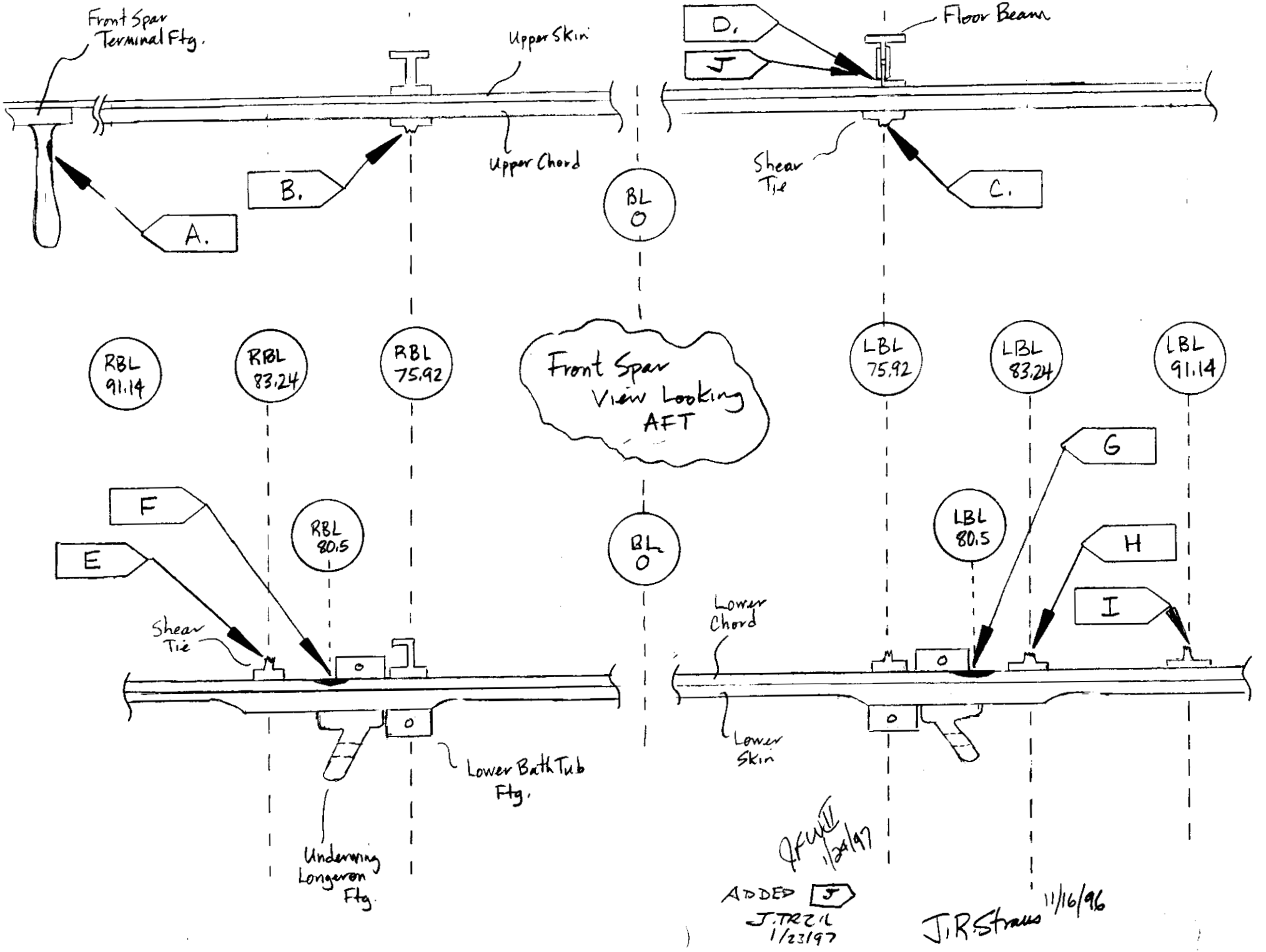
H Lower Chord to Stiffener Shear Tie at LBL 83.24. Crack initiated at AFT/INBD Corner. Crack dimensions ≈ 0.08" x ≈ 0.2". JE

I Lower chord to Stiffener shear Tie at LBL 91.14. Crack initiated at AFT/INBD Corner. Crack dimensions ≈ 0.1" x ≈ 0.2". JE

J SIMILAR TO D EXCEPT AT LBL 33.99, .25 IN. LONG APPROX., AND FROM FWD SIDE OF HOLE. J. TRZIL 1-23-97 JE 1/24/97

Discovered by G. Fleis, J. Trzil, J. Straus

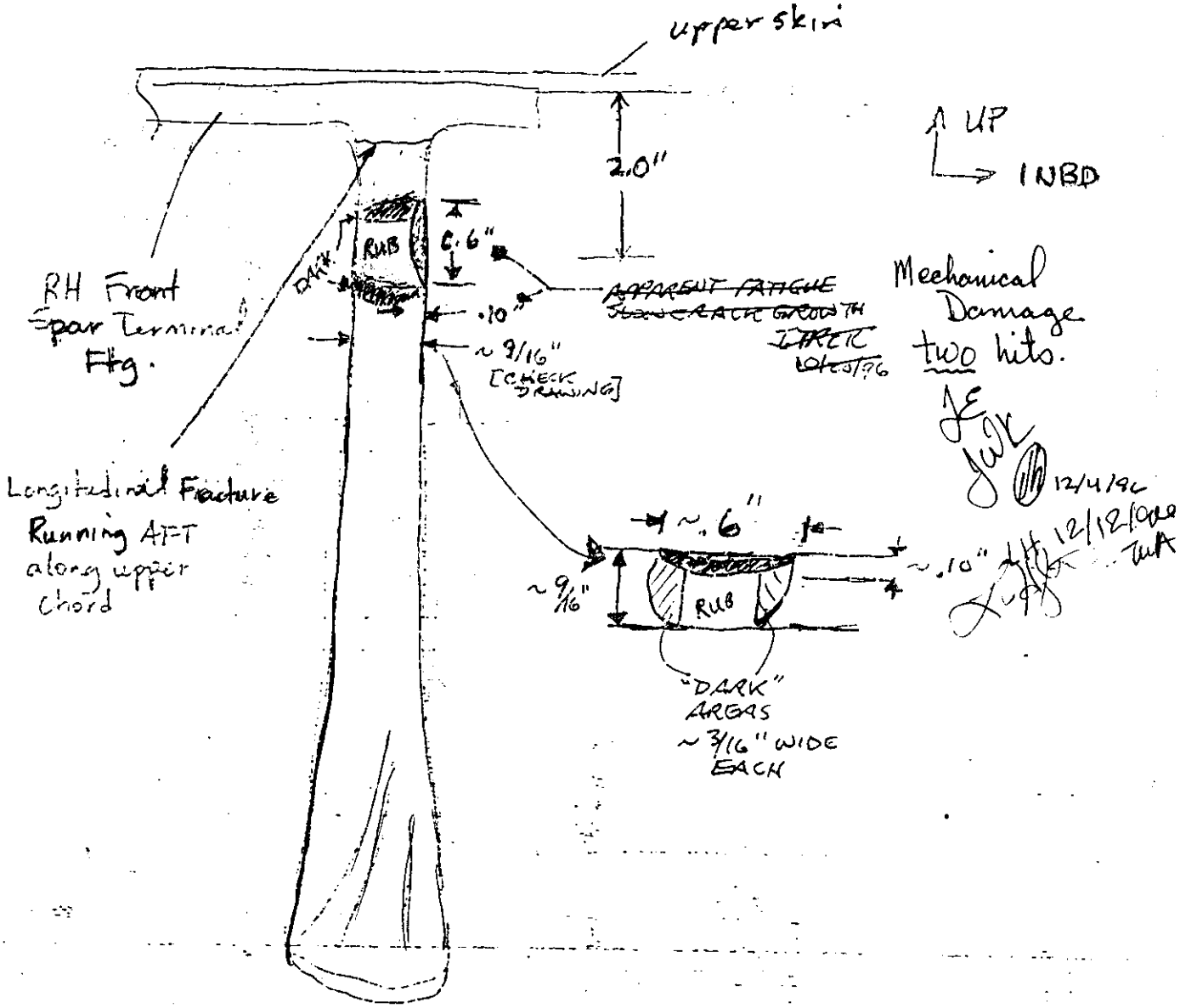
Confirmed by J.R. Straus 11/16/96


Front Spar Terminal Ftg.
Upper Skin
Upper Chord
A.
B.
D.
J
Floor Beam
Shear Tie
C.
BL 0
RBL 91.14
RBL 83.24
RBL 75.92
Front Spar View Looking AFT
LBL 75.92
LBL 83.24
LBL 91.14
G
F
E
RBL 80.5
BL 0
LBL 80.5
H
I
Shear Tie
Lower Chord
Lower Bath Tub Ftg.
Lower Skin
Underwing Longeron Ftg.
ADDED J
J.TRZIL 1/23/97
1/24/97
J.R.Strauss 11/16/96

LOCATION A

RW-7
GREEN C2151

Forward Fracture of RH Terminal Fitting at Upper Skin Att



~~APPARENT FATIGUE~~ ~~BACKREACH GROWTH~~ ~~DIRECT~~ ~~LOAD~~

Mechanical Damage two hits.

JE JWR 12/4/96

12/12/96 TWA

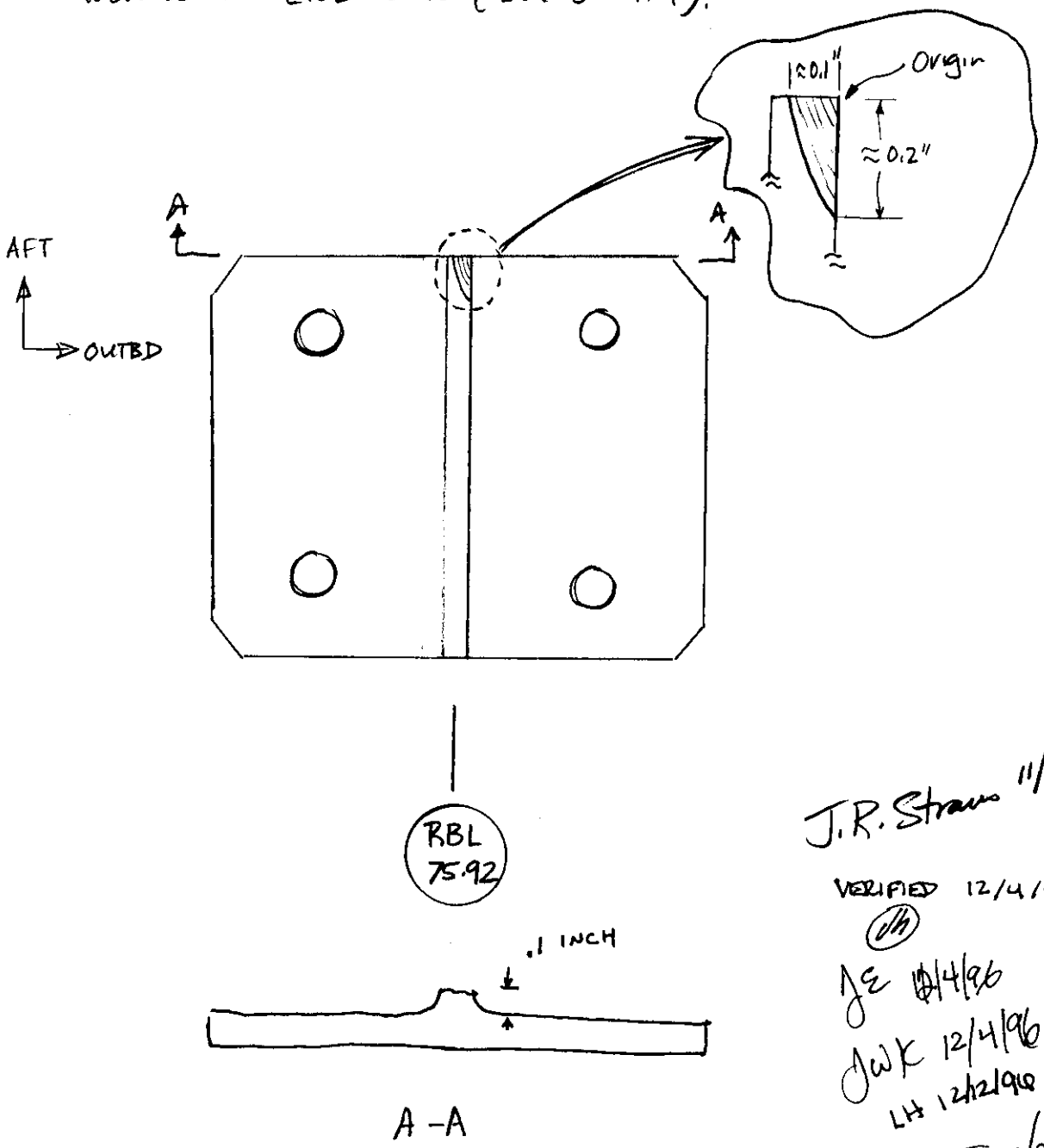
FOR G. FLEIS/
CONFIRMED J. STRAUS
J. TRCIL
10/18/96

LOCATION B

CW101

Apparent Fatigue Crack Location

- AFT End of Shear Tie fracture at front Spar Stiffener to Upper Chord at RBL 75.92. Similar crack located at LBL 75.92 (See CW114).



J.R. Straus 11/16/96

VERIFIED 12/4/96

JE 12/4/96

JWK 12/4/96

LH 12/12/96

JKW II 1/23/97

LOCATION C

CW-114
10/19/96
J. TRZIL

APPARENT FATIGUE CRACK LOCATION

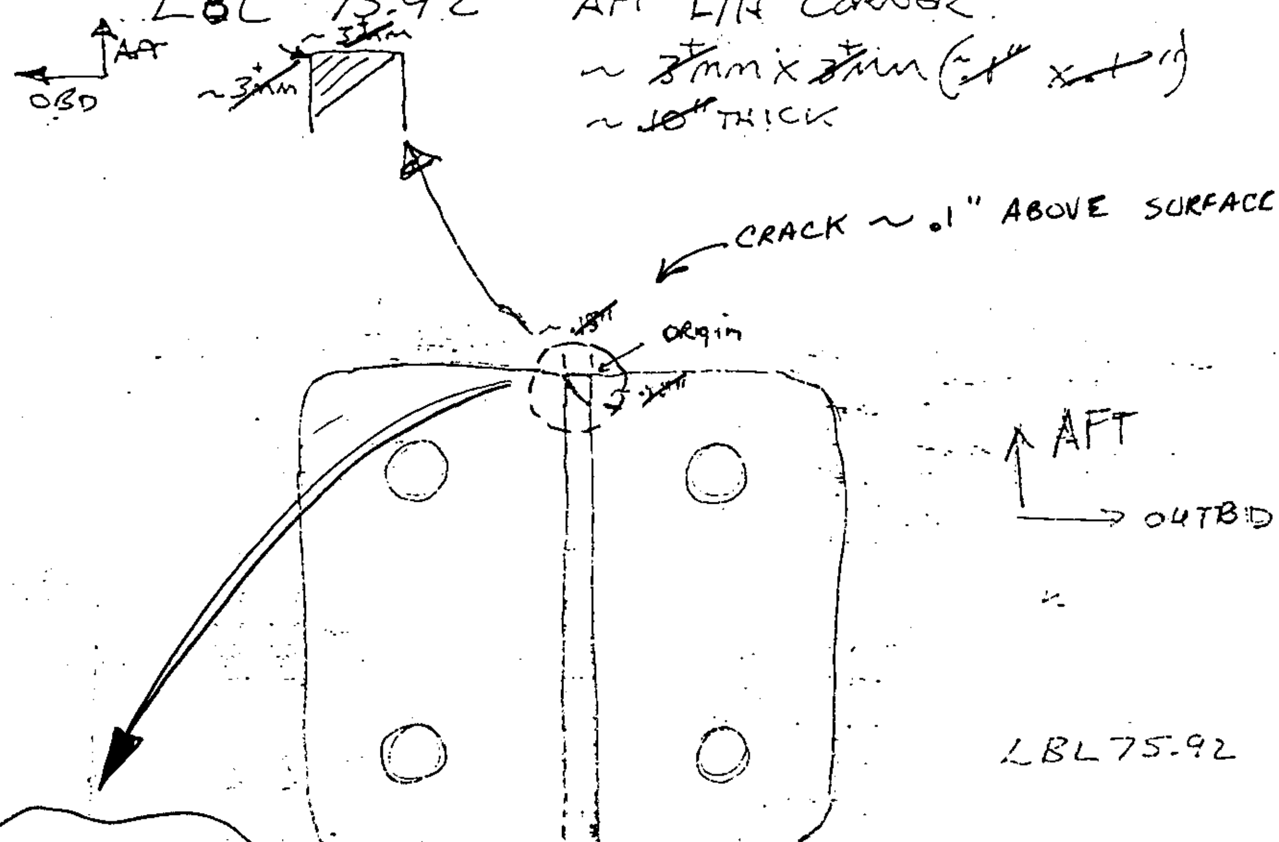
[C413 GREEN TAG]

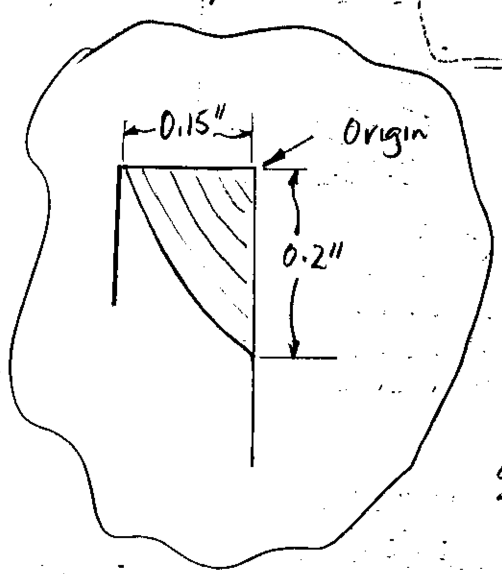
F.S. UPR CHORD SHEAR TIE #23028

LBL 75.92 AFT L/H CORNER

~ ~~3~~mm x ~~3~~mm (~~~.1"~~ x ~~.1"~~)

~ ~~.10"~~ THICK





Stephen F. Klapacz II Jr.
FAA 11-04-96 No Photo

JE 12/4/96

JW

JWK

LH 12/12/96

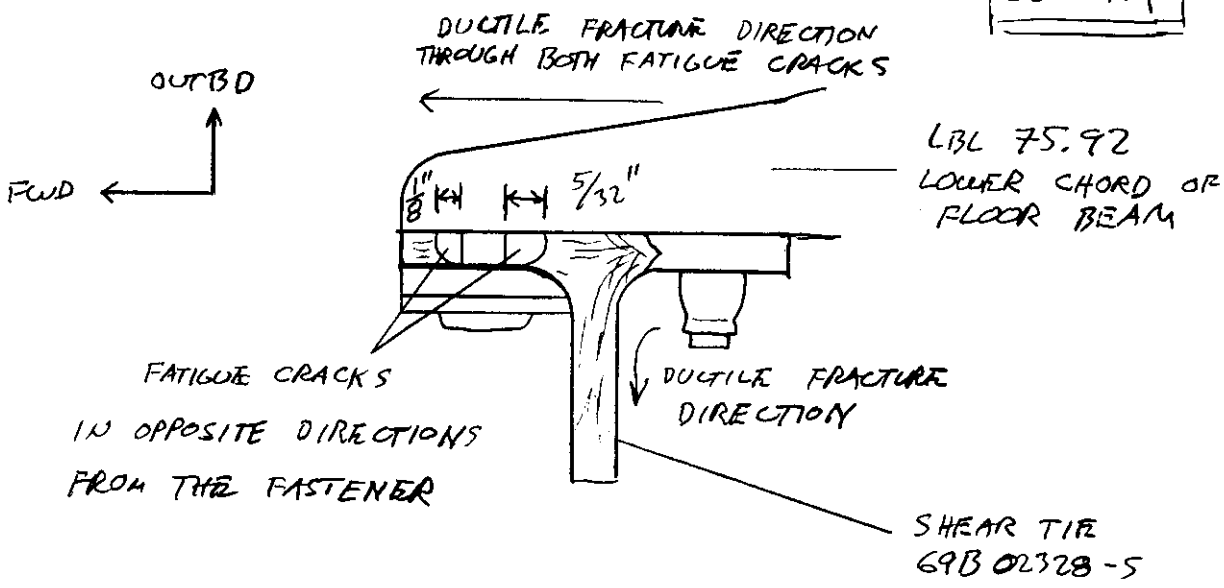
Similar Apparent fatigue crack noted on CW101 at RBL 75.92.

J.R. Strauss 11/16/96

JFW II
1/23/97

LOCATION D

CW-114



VIEW LOOKING UP

FLOOR BEAM TO FRONT SPAR SHEAR TIE AT LBL 75.92

G. FLEIS 11/7/96

Confirmed J.R. Strauss 11/13/96

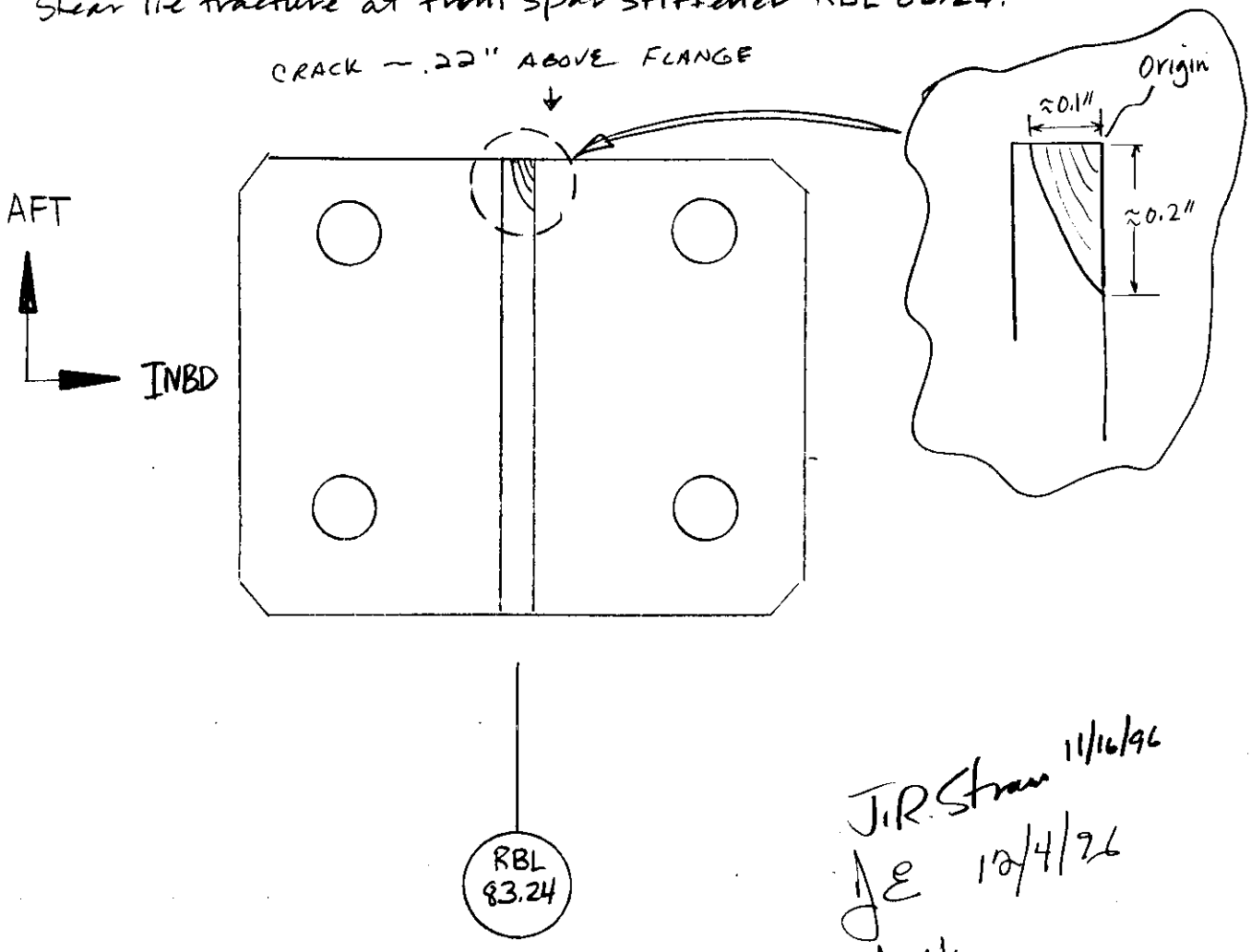
JE 12/4/96

LH 12/12/96

CW 216

LOCATION E

Apparent Fatigue Crack Location - AFT/INBD Corner of Shear Tie fracture at front Spar Stiffener RBL 83.24.



J.R. Straw 11/16/96

JE 12/4/96

LH 12/12/96

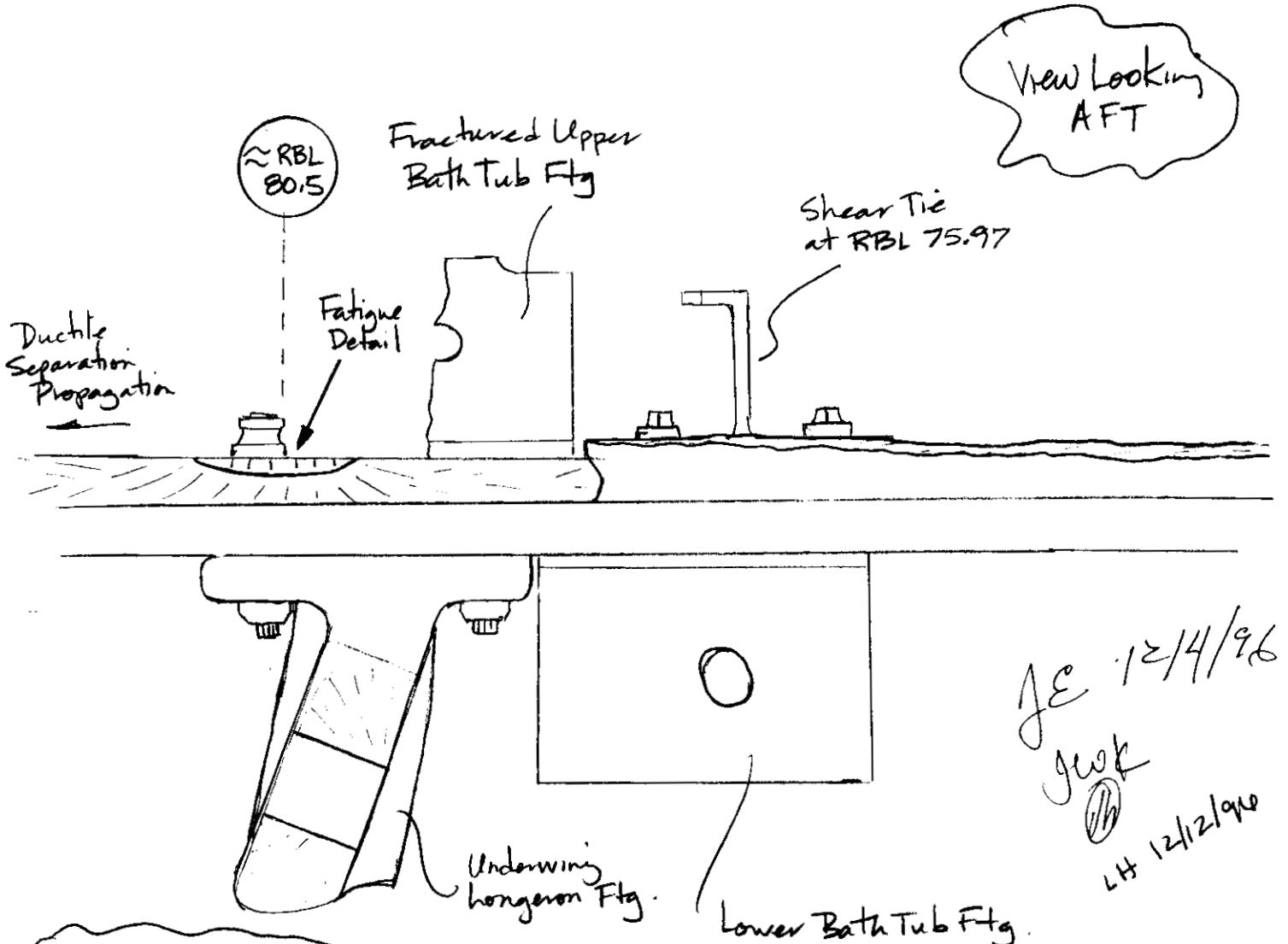
QFCW II 1/23/97

LOCATION F

CW216

Apparent Fatigue Crack Location –

Front Spar Lower Chord at ≈ RBL 80.5

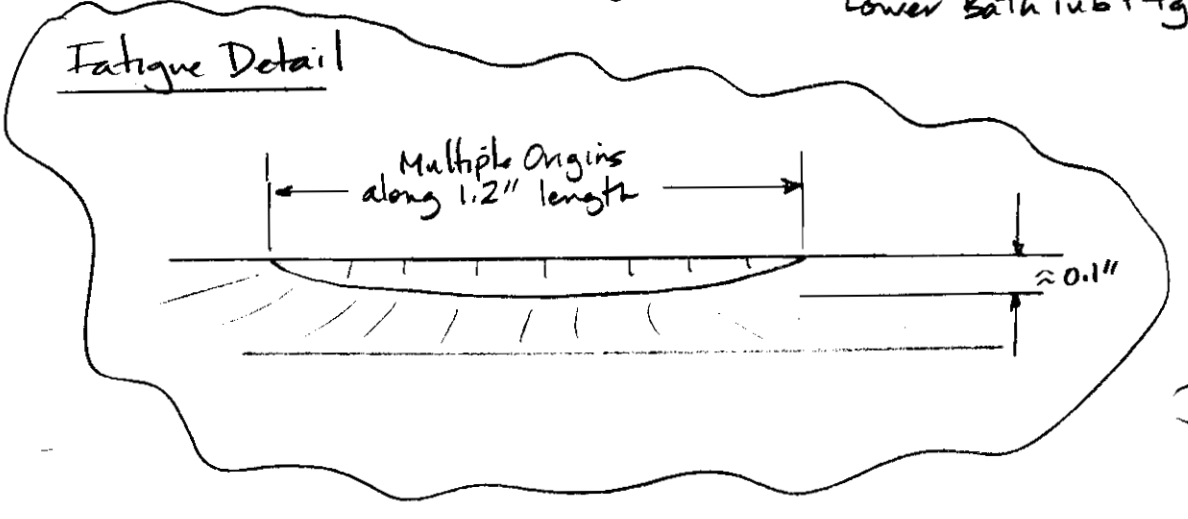


JE 12/4/96

JWK

LH 12/12/96

Fatigue Detail



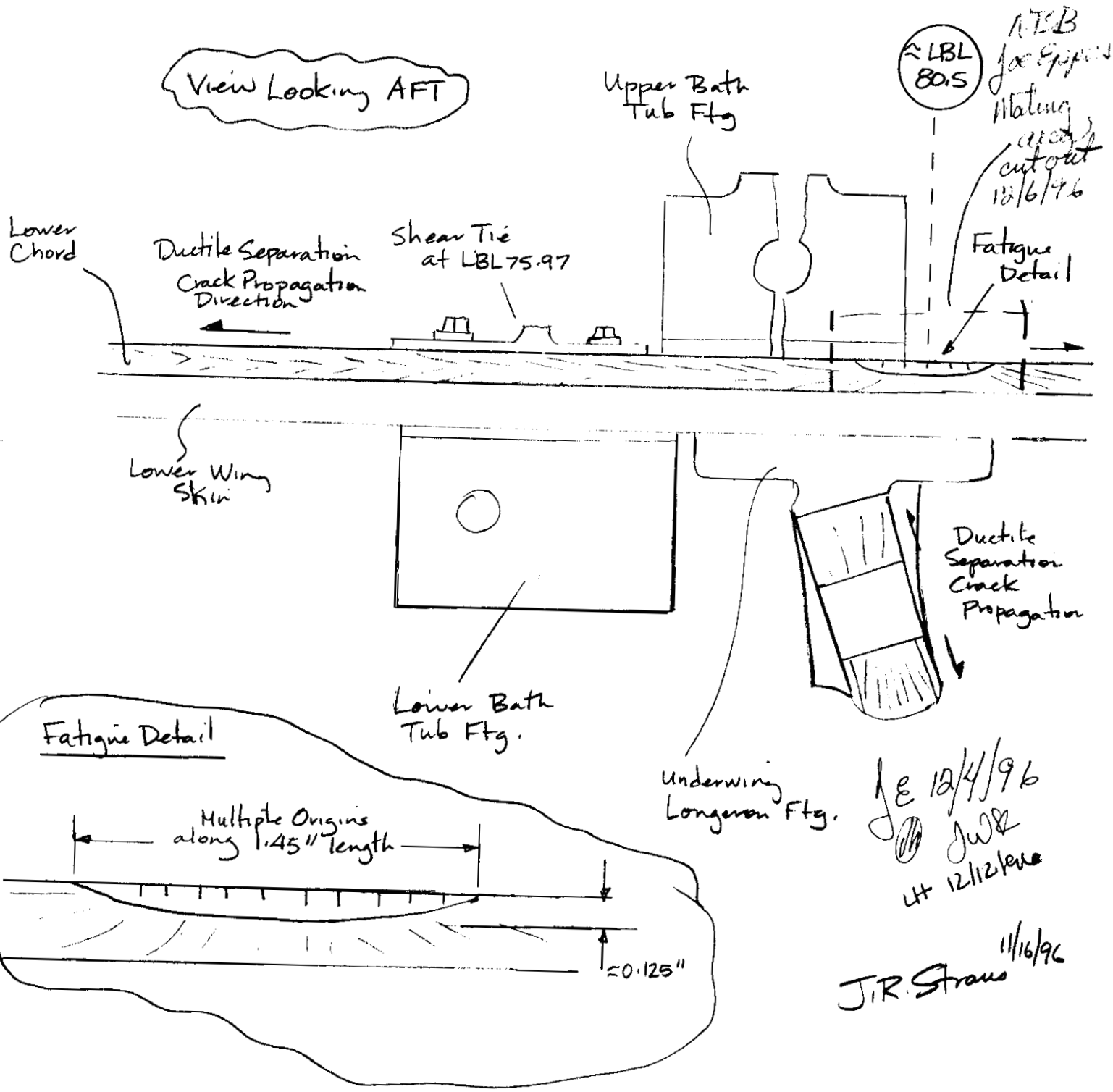
J.R. Straus 11/16/96

LOCATION G

CW22

Apparent Fatigue Crack Location -

Front Spar Lower Chord at ≈ LBL 80.5.



JE 12/4/96
JW
LH 12/12/96

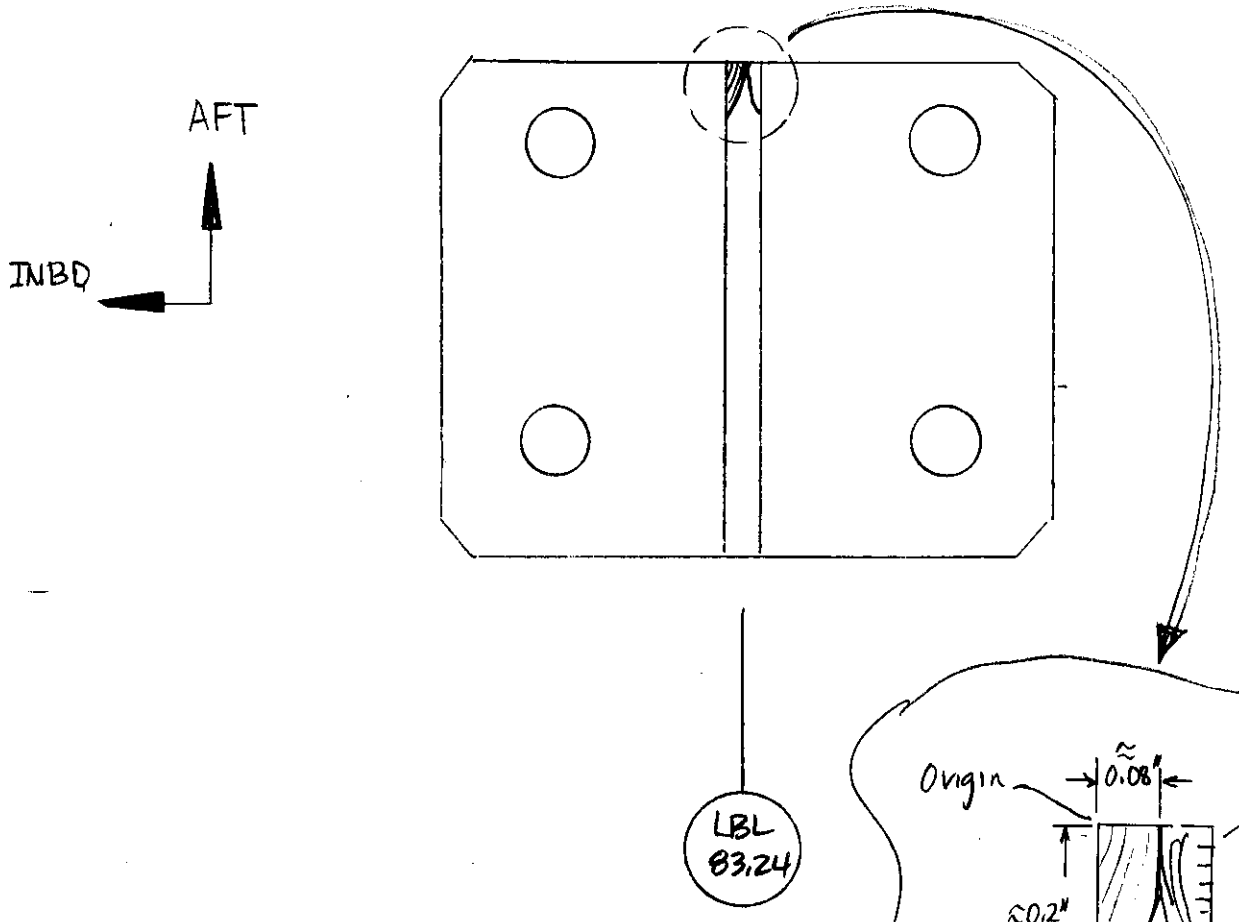
11/16/96
J.R. Strauss

CW 221

LOCATION H

Apparent Fatigue Crack Location - AFT/INBD Corner of Shear Tie fracture at Front Spar Stiffener LBL 83.24.

CRACKS ~.15" ABOVE FLANGE



JE 12/4/96

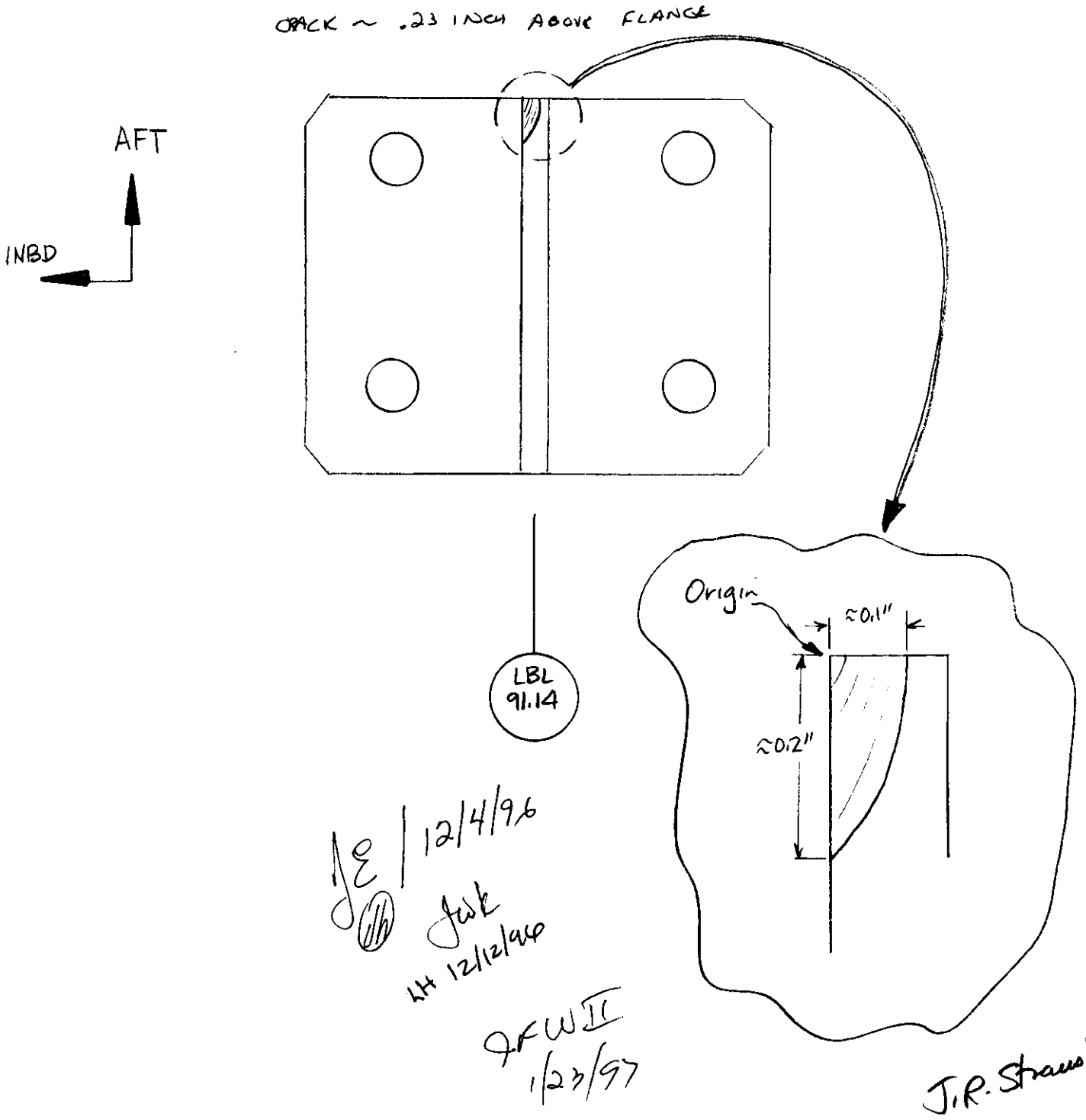
JWE need to be verified LH 12/12/96 11/16/96

J.R. Strauss

CW 221

LOCATION I

Apparent Fatigue Crack Location - AFT/INBD Corner of Shear Tie fracture at front Spar Stiffener LBL 91.14.



JE | 12/4/96

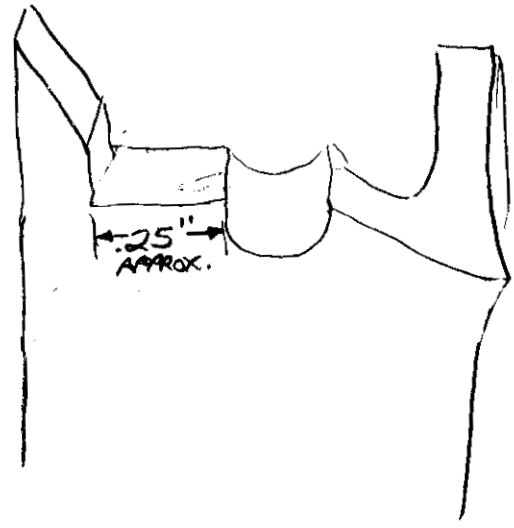
JWL 12/12/96

QFWII 1/23/97

J.R. Straus 11/16/96

LOCATION J

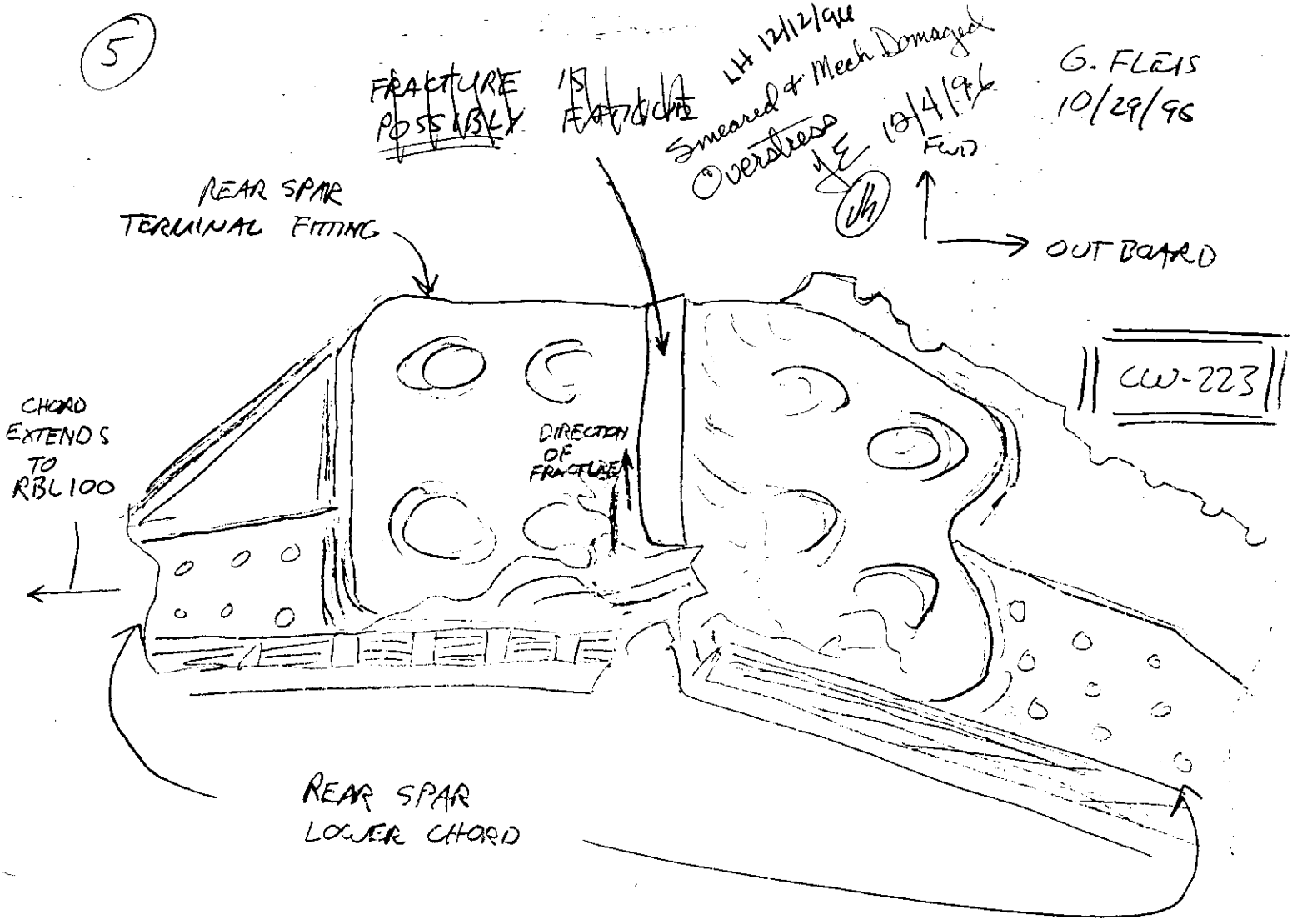
CW-502
J. TREIL
1-23-97



FLOOR BEAM TO FRONT SPAR
SHEAR TIE AT LBL 33.99

1/24/97

(5)



VISIBLE FEATURES:

1. FLAT PROFILE FOR 1.0 – 1.25 INCHES
2. GENTLE TRANSITION TO SLANTED PROFILE
3. HAMMERED SURFACE (SHINEY) IN THE FLAT PROFILE REGION.

NOTE: THERE'S A SECOND CRACK ABOUT 3/8" BELOW THIS FRACTURE, CAN'T CHARACTERIZE IT WITHOUT REMOVING SEALANT FROM THE AREA.