# FATIGUE TESTING OF RIBBED ORTHOTROPIC PLATE BRIDGE ELEMENTS

By

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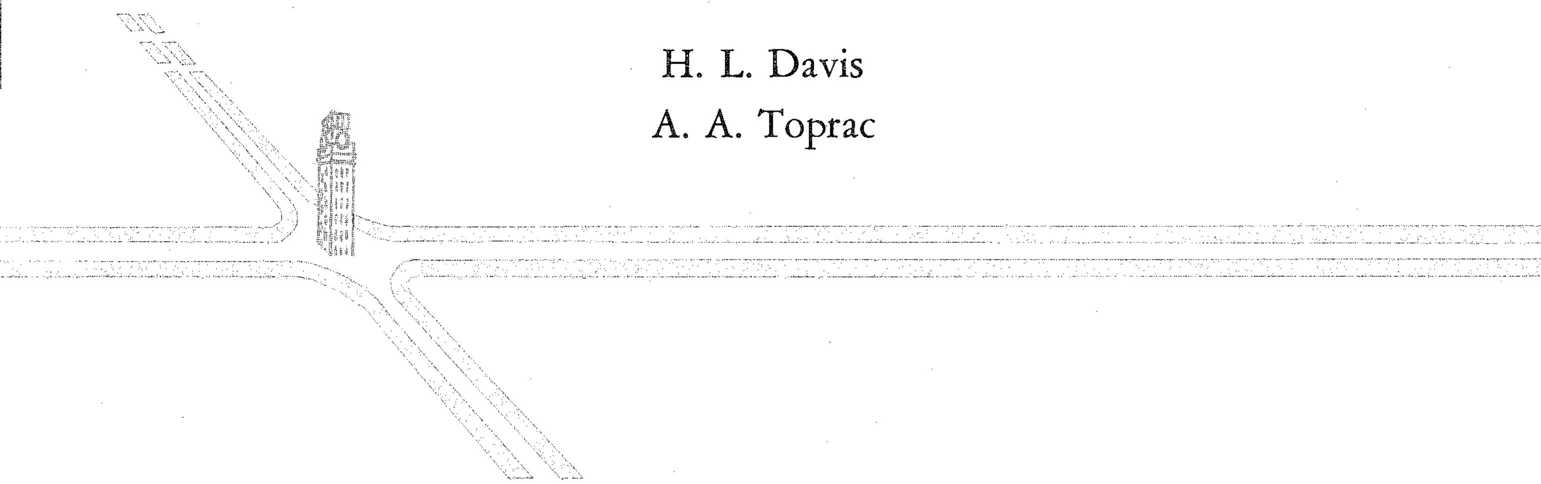

Summary Report 77-1 (S)

SUMMARY OF

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# FATIGUE TESTS OF ORTHOTROPIC PLATE BRIDGE ELEMENTS

Tests on four full size orthotropic plate bridge specimens were conducted at The University of Texas, to observe their fatigue behavior under repeated loading, to investigate the influence of joint details between rib and deck plate on fatigue life, and to examine types of field splices that can be used in such bridges.

## The Specimens

The specimens shown in Fig. 1 were 18 ft. long and had their cross-section composed of 47 in. x 7/16 in. deck plate with two symmetrically placed 11 1/2 in. deep trapezoidal shape ribs 1/4 in. thick. The two joint details investigated are also shown in the same figure.

In Fig. 2 rib splice details are depicted with and without diaphragm splice plate. In the former case, two ribs were brought against each face of the plate and welded by a fillet weld. In the latter case two beveled rib edges were joined by butt weld with 1/8 in. back up strip. All materials conformed to ASTM A36. All weldings were done manually using AWS E7018 and E6010 electrodes.

## Test Procedure and Results

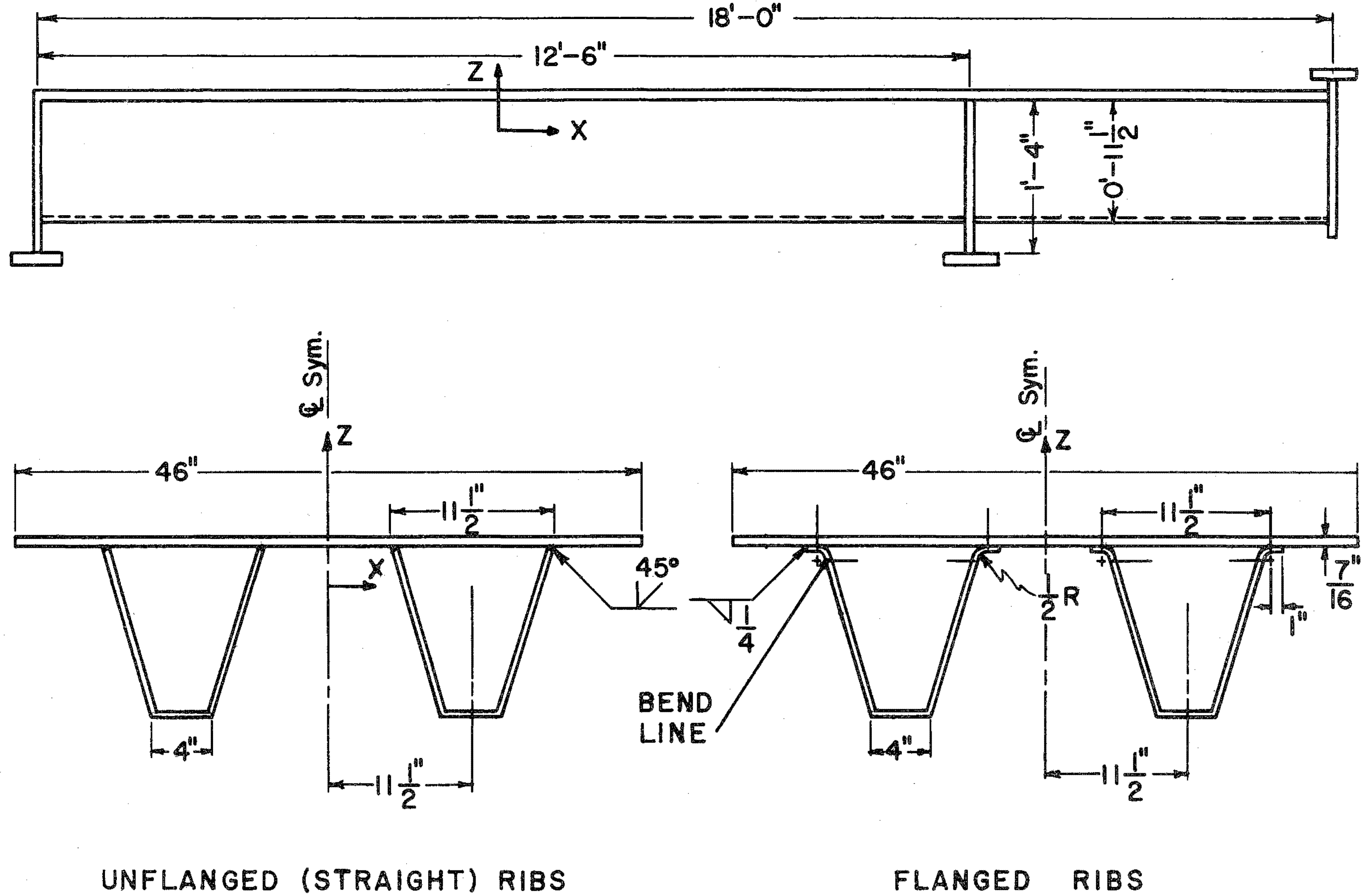
The test specimens were subjected to linear moment gradient except under the uniformly distributed block load. The load was applied by a hydraulically operated jack which was connected to pulsator providing sinusoidal pressure at 250 cycles per minute. In order to attain an uniformly distributed load, a 2 in. thick, 60 durometer butyl pad was used under 12 in. x 24 in. steel loading plate -- Fig. 3.

The load ranges and maximum and minimum applied loads, are presented in tabular form in Table I. On the last column of this table the number of cycles to the initial crack and the total number of repeated load cycles are also given. A complete testing history for Specimen 4 is presented in Fig. 4 as typical for all specimens. In all cases testing was planned to terminate at 2,000,000 cycles.

## Conclusions

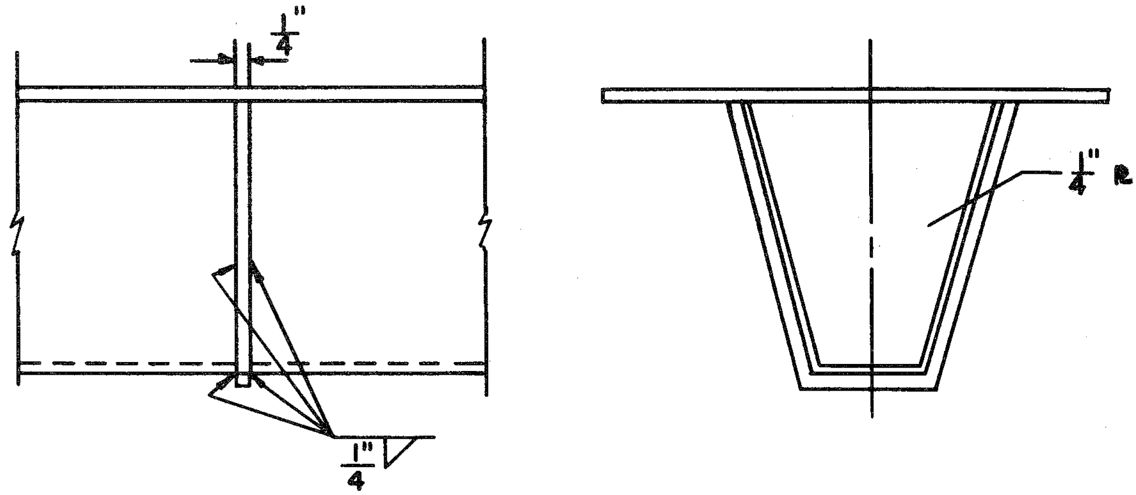
Based on the limited number of specimens used in this investigation the following conclusion can be drawn:

1. Results show that the unflanged rib connection to deck plate endures more fatigue load and has better fatigue life than the flanged rib.
2. Rib and deck splices in regions of high bending moment should be avoided and in any case butt weld splice should be given preference over a splice with diaphragm and fillet welds.

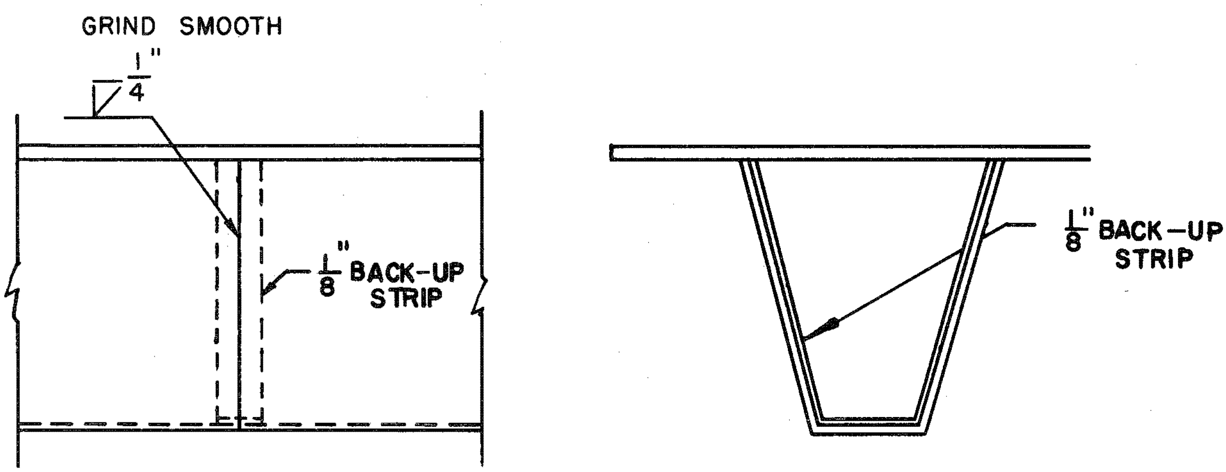



TEST SPECIMEN

FIGURE 1.



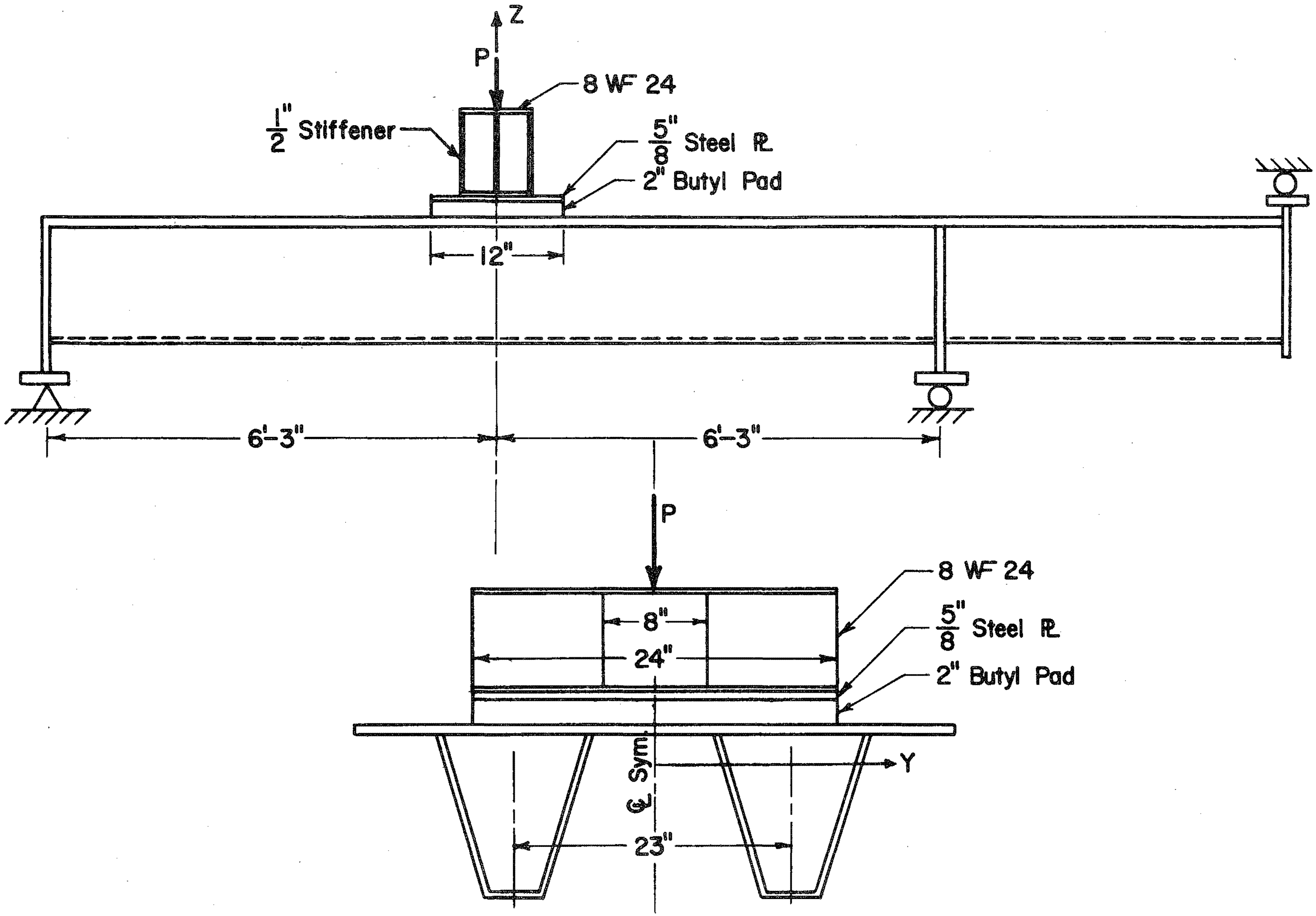

DIAPHRAGM SPLICE




BUTT WELD SPLICE

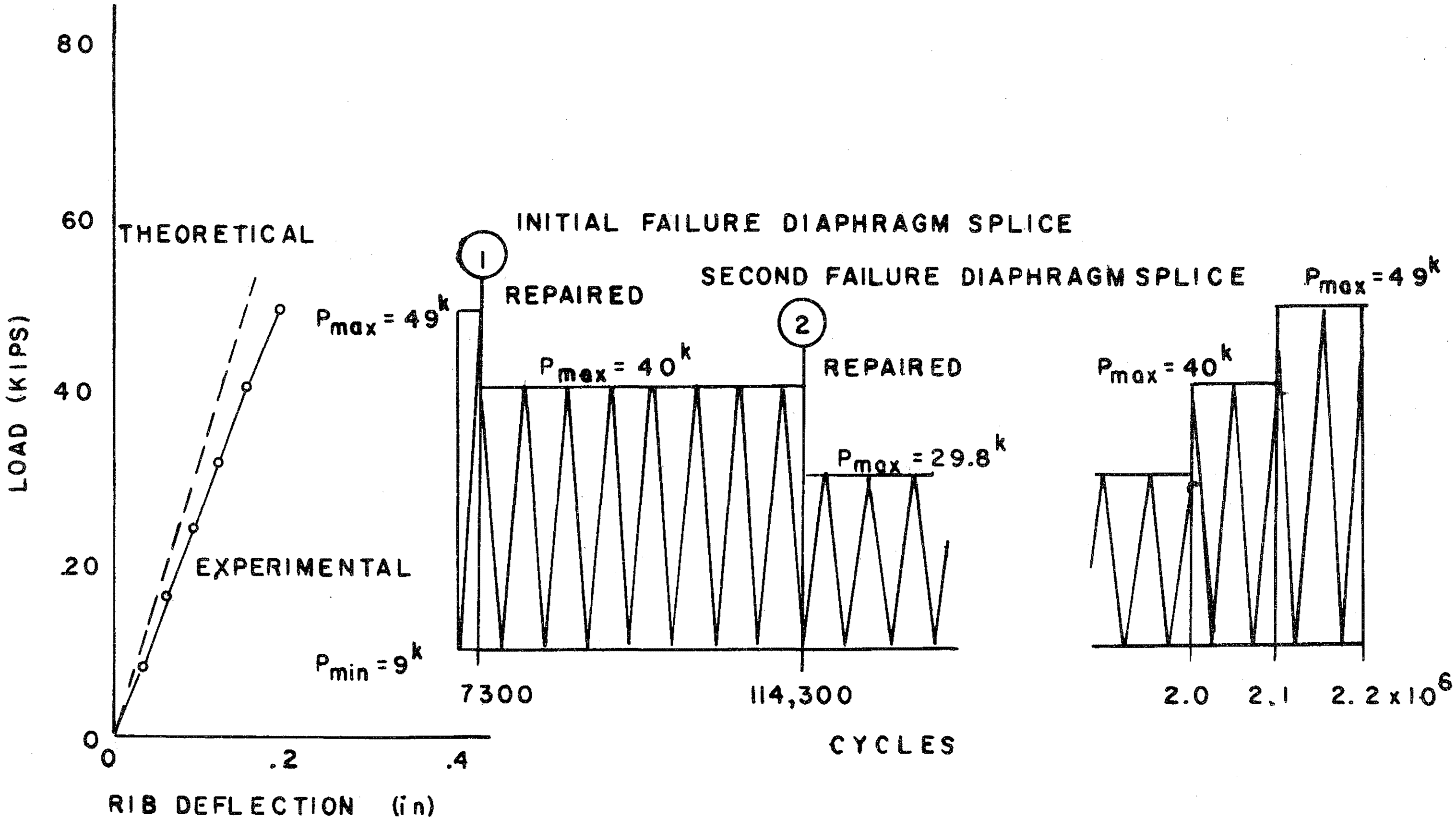
RIB SPLICES

FIGURE 2.




TEST SET UP

FIGURE 3.




FATIGUE TEST RESULTS
Specimen 4 (Unflanged)

FIGURE 4.

TABLE 1. Fatigue Test Results

| Specimen No. | Specimen Type | Test No. | $P_{max}$ kips | $P_{min}$ kips | Equivalent Wheel Loads[b] $P_{max}$ | $P_{min}$ | (load range) $P_{max} - P_{min}$ | Cycles[a] |
|---|---|---|---|---|---|---|---|---|
| 1 | Flanged | 1 | 83.0 | 8.3 | 4.00 | .40 | 3.60 | 10,000[c] |
| | | 2 | 49.0 | 9.0 | 2.36 | .43 | 1.93 | $2 \times 10^6$ [d] |
| 2 | Flanged | 3 | 40.0 | 9.0 | 1.93 | .43 | 1.50 | 36,000[c, e] |
| 3 | Straight | 4 | 83.0 | 8.3 | 4.00 | .40 | 3.60 | 10,000 |
| | | 5 | 49.0 | 9.0 | 2.36 | .43 | 1.93 | $2 \times 10^6$ |
| 4 | Straight Diaphragm Splice | 6 | 49.0 | 9.0 | 2.36 | .43 | 1.93 | 7,300[c] |
| | | 7 | 29.8 | 9.0 | 1.43 | .43 | 1.00 | 107,000[c] |
| | Belt Type Splice | 8 | 29.8 | 9.0 | 1.43 | .43 | 1.00 | $2 \times 10^6$ |
| | | 9 | 40.0 | 9.0 | 1.93 | .43 | 1.50 | 100,000 |
| | | 10 | 49.0 | 9.0 | 2.36 | .43 | 1.93 | 100,000 |

a Total number of cycles at a given load

b Based on H-20 Truck Load plus 30% impact or 16 + 0.3 x 16 = 20.8 kips

c Weld failure occurred at number of cycles shown

d Weld failure at 35,000 cycles

e Weld failure at 20,000 cycles