basis, all the fatigue strengths were corrected to correspond to 0.1 f_y minimum stress level using Modified Goodman Diagrams.

The test data in Fig. 8 indicated that the fatigue strength of the deformed bars decreases when the ratio of radius to lug height is less than about 1.25 and is almost constant for r/h ratios greater than 1.25. These results tend to confirm stress concentration calculations.

The average r/h ratio for North American bars is in the order of 0.25. According to the line plotted in Figure 8 the fatigue strength of reinforcing bars could be increased by about 30 percent by increasing the r/h ratio for the deformations to 1.25 or greater.

The above observations suggest that by adding additional clauses specifying a minimum lug base radius to lug height (r/h) equal to 1.25 and a maximum width to height ratio for lugs, a specification for higher fatigue strength deformed bars could be developed.

ACKNOWLEDGEMENTS

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TABLE 1

K_T for Projecting Lugs

	h/D = 0.05						h/d = 0.1
r/h	w/h = 1			w/h = 2			w/h = 2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Θ = 45	Θ = 52.5	Θ = 60	Θ = 45	Θ = 52.5	Θ = 60	Θ = 45
0.1	2.084	2.095	2.141	2.527	2.568	2.664	2.523
0.25	1.850	1.861	1.904	2.225	2.284	2.303	2.222
0.50	1.656	1.680	1.714	1.934	1.971	2.020	1.933
1.00	1.446	1.491	1.533	1.638	1.688	1.716	1.634
1.50	1.440	1.442	1.453	1.532	1.595	1.623	1.527

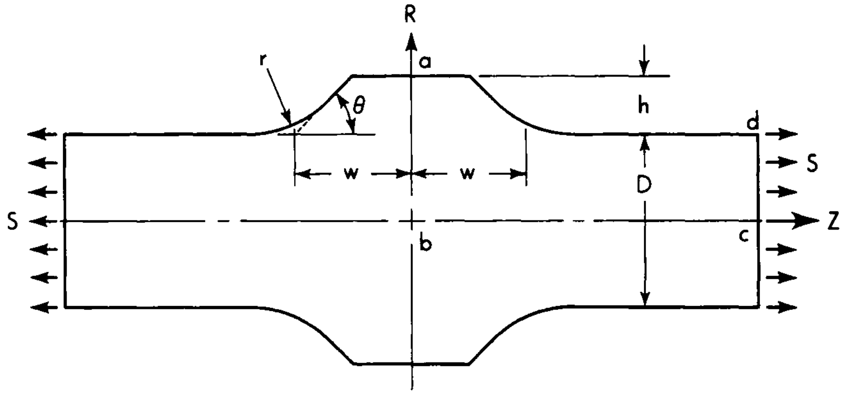
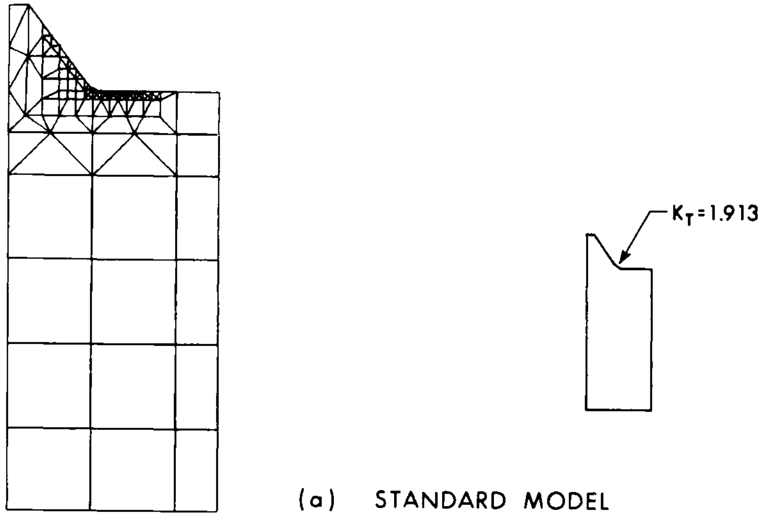


FIGURE 1 AXI - SYMMETRICAL PROJECTING LUG MODEL



(a) STANDARD MODEL

FIGURE 2 TYPICAL FINITE-ELEMENT MODEL

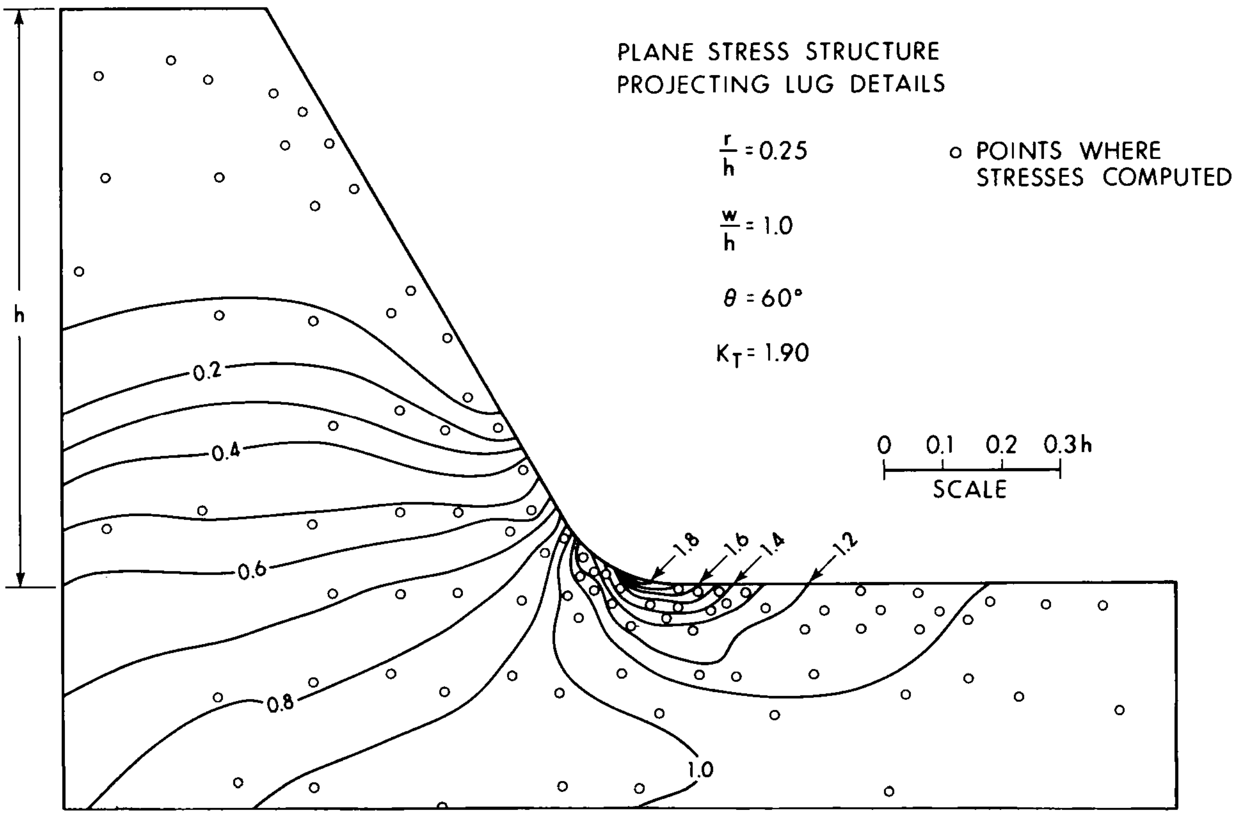


FIGURE 3 CONTOUR MAP OF STRESS CONCENTRATIONS AT THE BASE OF PROJECTING LUG

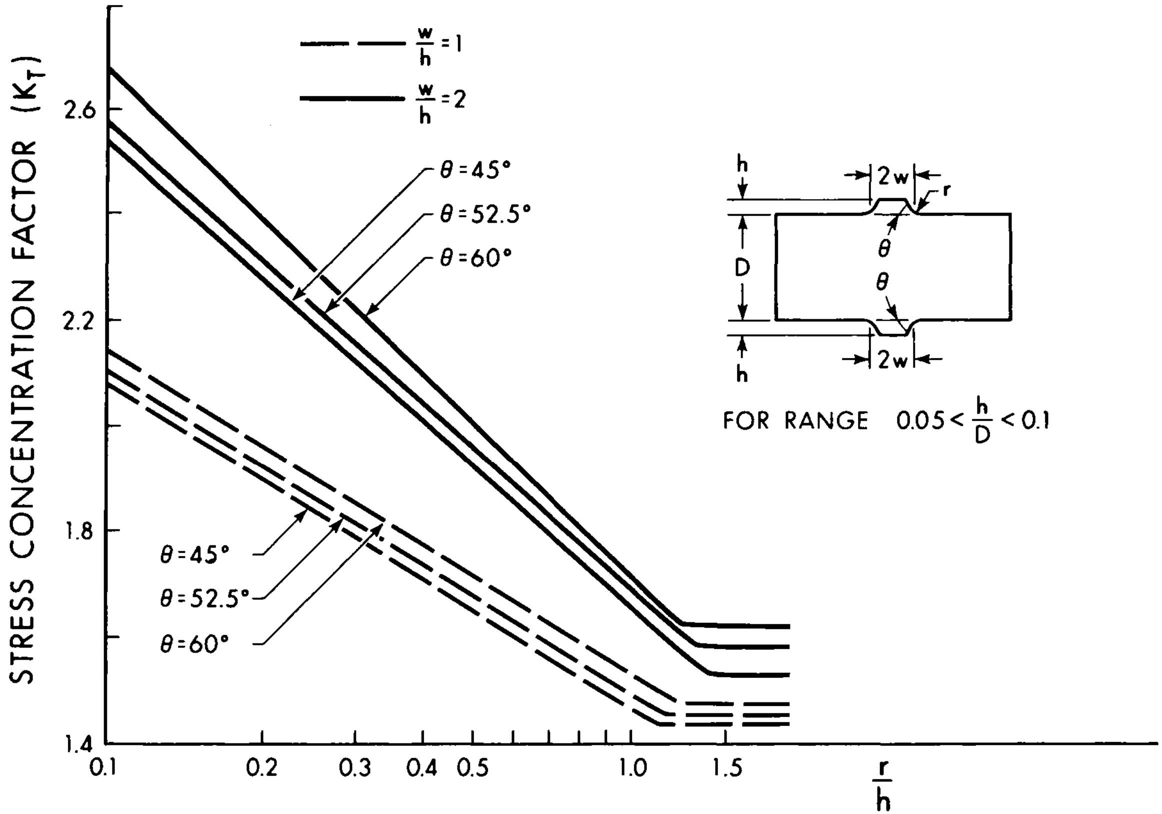


FIGURE 4 EFFECT OF PROJECTING LUG PARAMETERS ON K_T

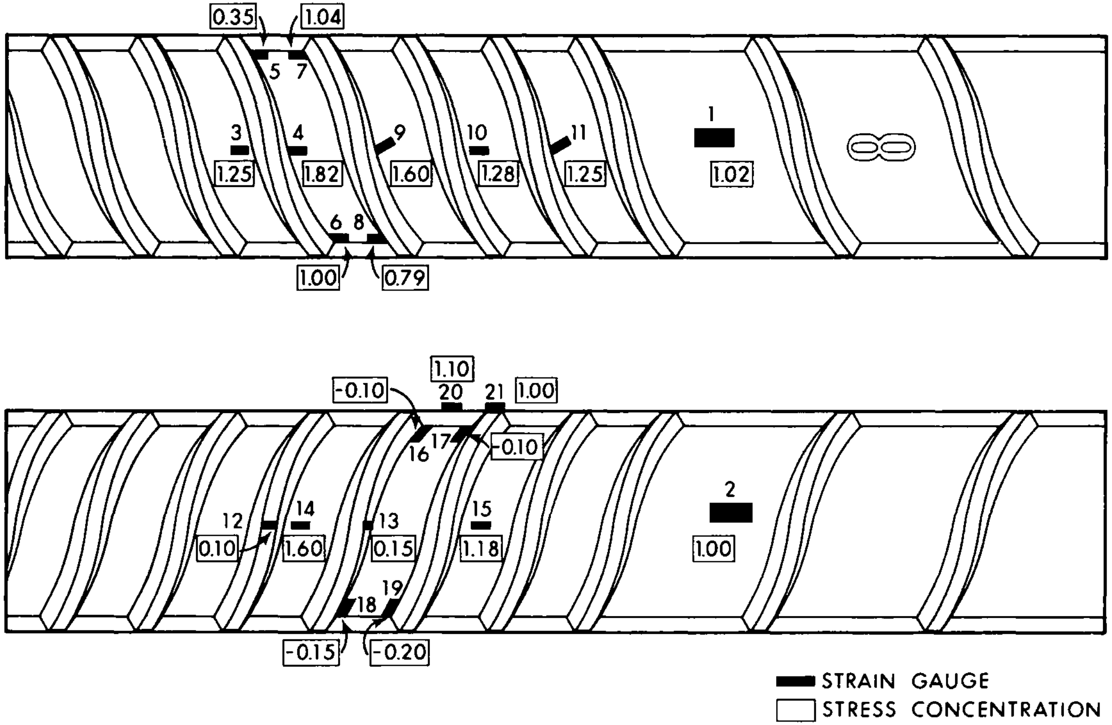


FIGURE 5 STRESS CONCENTRATION MEASUREMENTS ON DEFORMED BAR

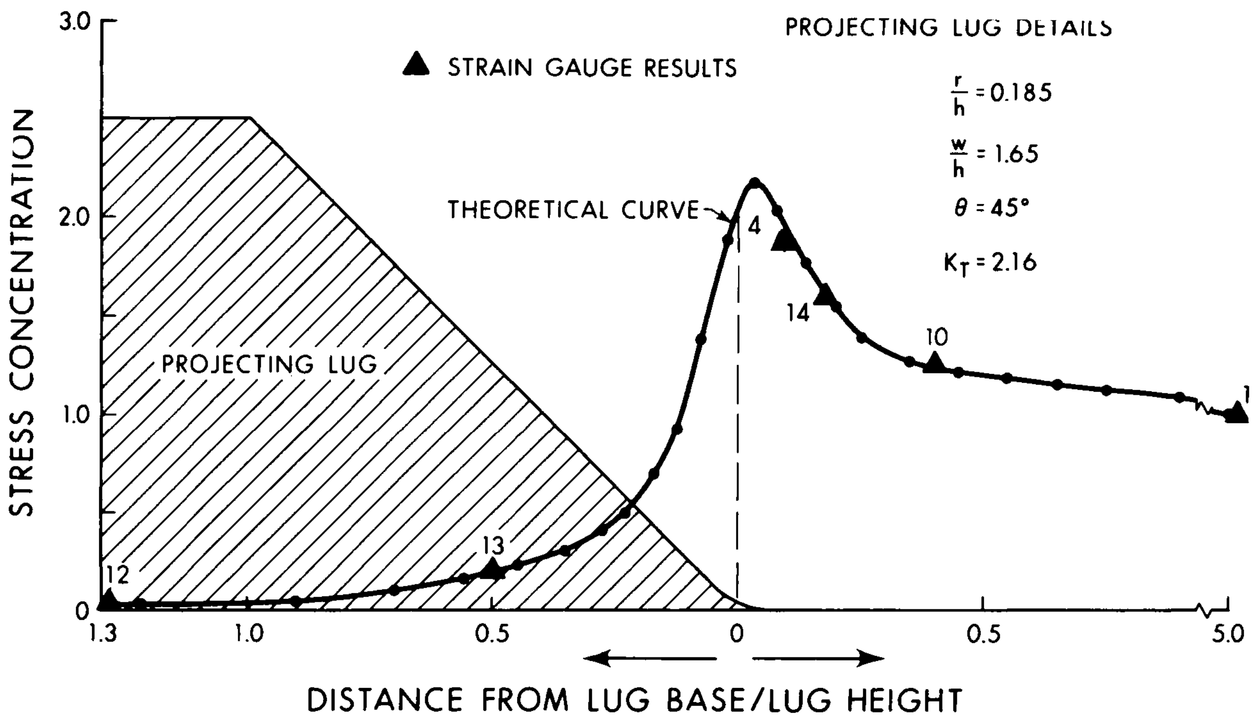


FIGURE 6 STRESS GRADIENT AT BASE OF PROJECTING LUG

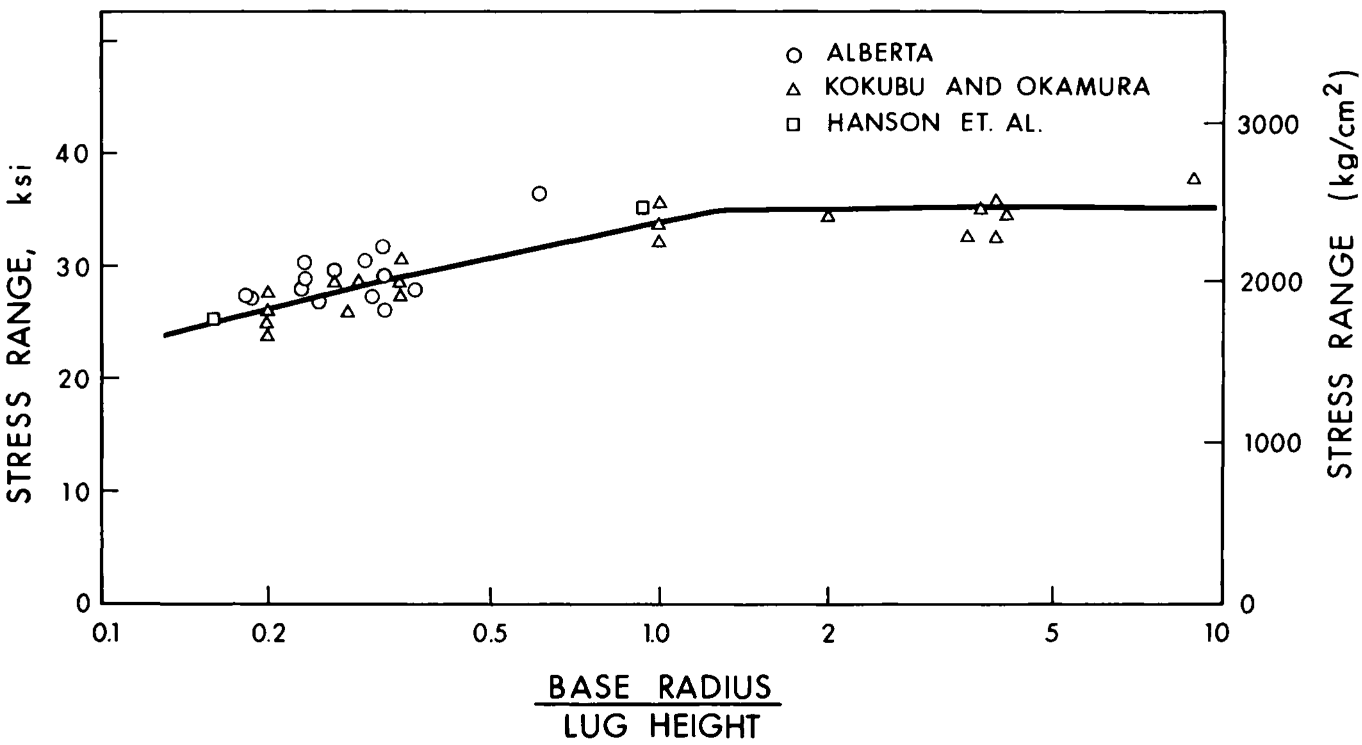


FIGURE 7 EFFECT OF r/h ON FATIGUE STRENGTH, $S_{min} = 0.1 f_y$

SP 41-9

Fatigue Characteristics Of Welded Wire Fabric

By
N.M. Hawkins and L.W. Heaton

Synopsis: Results are reported of tests to determine the factors dictating the short life fatigue characteristics in air of a square smooth welded wire fabric consisting of No. 2 wires at 6 inch (15 cm) centers. Fifty nine welded intersections were cut at random from sheets of the fabric, their dimensions recorded, and the longitudinal wires in the original fabric subjected to tensile stress ranges of 31.4, 41.5 and 53.1 ksi (2210,2920,3740 kgf/cm^2).

It was found that the fatigue characteristics were dictated by stress concentration effects caused by the welded intersections and that the characteristics were not markedly influenced by metallurgical changes caused by the welding operation. When there was a cold weld, the penetration was usually less than 0.027 inch (0.07 cm) and there was no discoloration of the longitudinal wire. When there was a hot weld, the penetration was generally more than 0.027 inch (0.07 cm) and there was marked discoloration of the longitudinal wire. With a hot weld molten metal was pushed into the intersection. As that metal cooled, cracking developed between it and the parent wires. The resultant stress concentration reduced the fatigue life value at a given stress range to half that for a cold weld. Stress-cycle-probability curves are developed for the fabric, and it is shown that at a given stress range fatigue life values for the 95, 50 and 5 percent probability were comparable to values for high yield deformed reinforcing bars.

Keywords: bending; cracking (fracturing); deformations (reinforcing steels); fatigue (materials); fatigue tests; reinforcing steels; static tests; stresses; welded wire fabric.

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INTRODUCTION

For highway structures such as bridge decks, box culverts, and continuous pavements, cost studies have shown that there can be economic advantages to the use of welded wire fabric. Engineers are, however, reluctant to use fabric because of a widespread belief that stress concentrations caused by the welded intersections will result in poor fatigue characteristics. The overall objective of this study was to examine quantitatively the validity of that belief. Tests were conducted in air on individual wire specimens containing a welded intersection and the results of those tests correlated with the results of fatigue tests on slabs reinforced with the same fabric. The results of the wire tests are summarized in this paper and the results of the slab are summarized in Reference 1.

TEST PROGRAM

The test program is briefly summarized in this section. More comprehensive details of the test program and the analysis of the results are contained in Reference 2.

Test Specimens

Static and fatigue tests were made on "cross-weld" specimens cut at random from six "as-delivered" 7-1/2 by 21 ft. (2.3 x 6.4 m) sheets of a smooth, square, welded wire fabric consisting of No. 2 gage (0.2625 inch (0.666 cm) diameter) wires at 6 inch (15 cm) centers. Each specimen contained a single, centrally located, welded intersection. The longitudinal and transverse wires were made 12 and 8 inches (30 and 20cm) long, respectively, and the specimens were cut so that the longitudinal wire in the specimen was also a longitudinal wire in the fabric.

Specimens were classified initially into three classes: A,B and C according to the appearance of the longitudinal wire at the welded intersection. For Class A welds the surface of the longtiudinal wire was smooth, and there was no discoloration. For Class B welds the surface was smooth, but there was marked discoloration. For Class C