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Discussion - Discussion - Diskussion

Fatigue Life of Structural Members¹⁾

Résistance à la fatigue des éléments de construction

Ermüdungserscheinungen von Konstruktionsteilen

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The question has been raised by the General Reporting Member for Theme II [1] that the tests undertaken in Germany on drilled test bars [2] cast doubt on the hypothesis "that the endurance limit does not depend, in the interesting range, on the ultimate strength and the yield point of the steel" [3].

Similar tests were reported by HANSEN in connection with tests of bolted and riveted joints [4]. However, the difference in fatigue strength was not nearly as great as indicated by Ref. [2]. In fact an examination of the test data shown in Fig. 1 shows that a large number of A 242 steel specimens exhibited essentially the same S-N curve as the A 7 steel specimens. The scatter

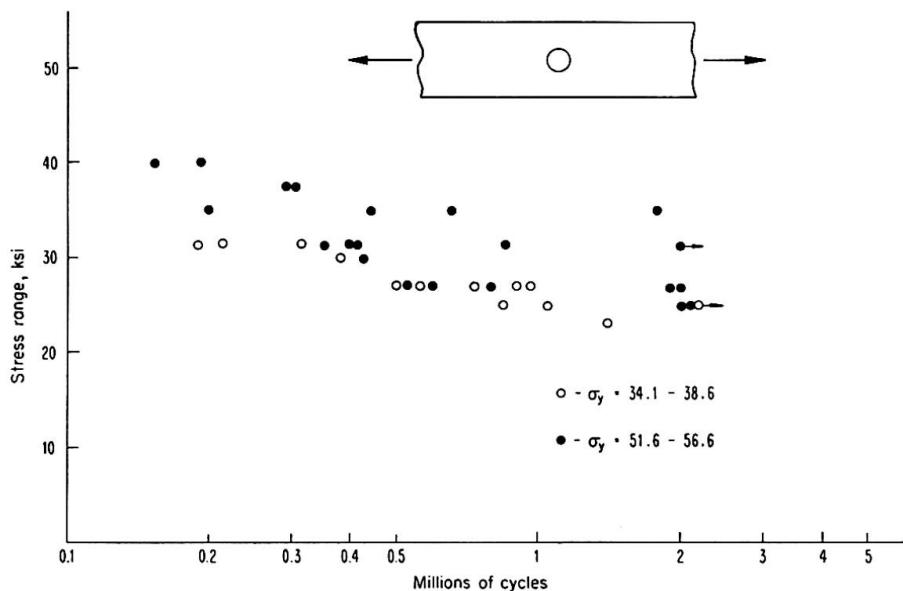


Fig. 1. Fatigue Tests of Plates with Hole.

¹⁾ See "Preliminary Publication" — voir «Publication Préliminaire» — siehe «Vorbericht», II d, p. 497.

of the A 242 steel specimens was considerably greater than the A 7 steel specimens. However, the lower bound of the high strength steel specimens was the same as the mild steel specimens.

Tests cited in Ref. [3] had indicated that for similar welded details the fatigue strength was approximately the same regardless of the type steel. Additional work continues to confirm this hypothesis. For example, unpublished reports of tests in progress at the University of Illinois (Refs. [5, 6]) indicate clearly that the higher strength steel specimens behaved similarly to the mild steel specimens with similar welded details.

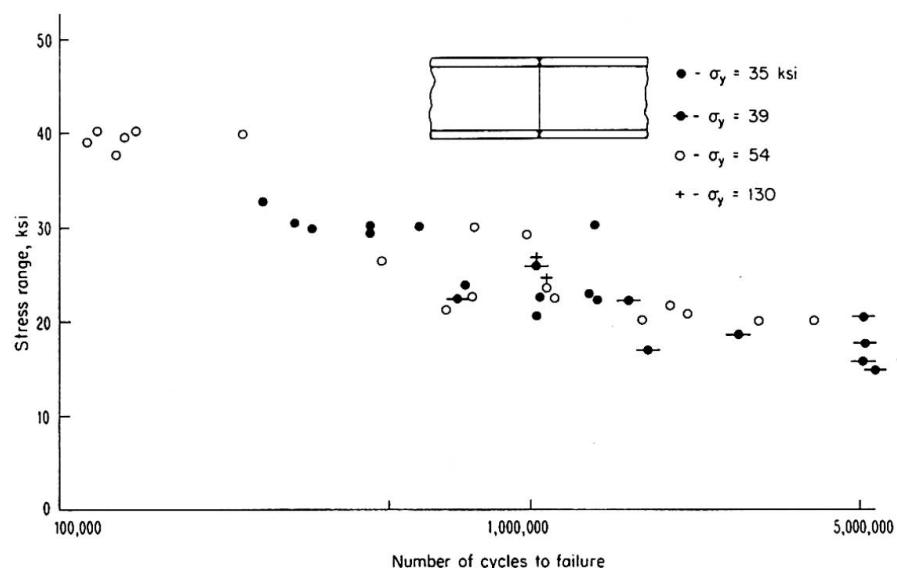


Fig. 2. Fatigue Tests Butt Welded Beam Splices.

Fig. 2 compares the results of tests on butt welded beam splices for mild steel, high strength steel and quenched and tempered alloy steel. The test data are taken from Ref. [5, 6, 7, 8]. No distinct difference exists in the S-N curves of these steels. Only a few tests have been conducted to date with the quenched and tempered steels. However, they are in agreement with the results for mild and high strength steel.

Other welded details such as butt splices with cope holes, stiffeners welded to the tension flange and beams with partial length coverplates have yielded similar results.

GURNEY [9] reported that a few tests carried out on ST 52 steel of German origin produced identical results to those obtained with BS 15 mild steel. Also, KONISHI [10] has tested longitudinal welded lap splices and butt welded splices and obtained essentially the same fatigue strength for high strength and mild steels. Insofar as known, the tests reported by KLÖPPEL and WEIHER-MÜLLER [11] on welded specimens fabricated from ST 52 are the only ones which have shown any improvement in strength over mild steel.

This particular divergence in results was discussed at some length at the

"Symposium on the Fatigue of Welded Structures" held at Cambridge University in 1960 [12]. It was pointed out that this question had been raised to Commission XIII of the International Institute of Welding and it was confirmed that ST 52 did not give better results than mild steel.

Hence, it can be concluded that further research and testing of the higher strength steels supports the proposed design hypothesis.

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Summary

Additional test results are summarized which support the generalized design approach proposed in the Preliminary Publications. It is further confirmed that the endurance limit does not depend, in the interesting range, on the ultimate strength and the yield point of the steel.

Résumé

Les résultats de nouveaux essais sont présentés de manière succincte et l'on constate qu'ils confirment la méthode généralisée proposée dans la "Pu-

blication Préliminaire". Il est une nouvelle fois vérifié que, dans le domaine qui présente pour nous un intérêt, la limite d'endurance ne dépend pas de la résistance à la rupture ni de la limite élastique de l'acier.

Zusammenfassung

Die Autoren fassen zusätzliche Versuchsergebnisse zusammen, welche das im «Vorbericht» vorgeschlagene verallgemeinerte Bemessungsverfahren unterstützen. Ferner wird der Beweis erbracht, daß die Ermüdungsgrenze des Stahls im maßgebenden Bereich nicht von dessen Zugfestigkeit und Fließgrenze abhängig ist.