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# Welded plate girders, Proposal

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WELDED PLATE GIRDERS

Proposal for Fatigue Tests  
on Welded Plate Girders  
No. 251-17

P R O P O S A L

Submitted to the

WELDED PLATE GIRDER PROJECT COMMITTEE

by

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July, 1960

## INTRODUCTION

Now that the investigation of the strength of mild structural steel welded plate girders under static loading is nearing completion and the results are being incorporated into design recommendations, several new topics concerning research on welded plate girders are being considered. One of these topics is the fatigue performance of a welded plate girder subjected to shear, where tension field action is to be taken into account.

Although the available jack capacity and ram stroke of the existing Amsler equipment at Fritz Laboratory is adequate to fatigue test girders with a  $3/16$ " x 50" web, it is not known for certain whether or not the chosen test setup will produce fatigue failure in the web of the test section before it occurs elsewhere. In order to settle this problem, it is proposed to conduct a pilot investigation now. This would give the advantage of having more information when a more extensive test series is proposed. On the other hand, should the pilot tests be successful, the committee might decide that the information gained would be sufficient to judge the influence of tension field action on the fatigue behavior of plate girders. At any rate, the results of the proposed tests would be a good basis for a discussion by the committee on this subject.

It should be mentioned that the present staff at Lehigh will be able to conduct the proposed tests and that existing funds originally committed for completion of past work will be adequate to cover the cost of the specimens and salaries of the investigating staff. Testing equipment would be furnished at Fritz Laboratory.

#### EXPERIMENTAL PROGRAM

It is proposed to initiate the fatigue investigation with dynamic tests on two girders, designated as girders F1 and F2. These girders, shown in Fig. 1, are essentially the same as girders G6 and G7 of the tests on plate girders subjected to shear (Report 251-13) with the exception that the flanges and cover plates have been increased from 3/4" to 1" in thickness. This was done to keep deflections down because of the stroke limitations of the testing equipment and to reduce the chance of a fatigue failure of the tension flange before a failure occurs in the web.

Cross sectional constants, reference moments, reference loads, and web buckling stresses for the two girders are presented in Table 1. All of these reference values have been defined and discussed in Report 251-11 and will not be discussed here. Also listed in Table 1 is the theoretical ultimate shear force,  $V_u$ , which a girder will carry and which

is determined from Eq. 3.14 of Report No. 251-8. For the test setup shown in Fig. 1,  $V_u$  is also the ultimate jack load for the girder, that is,  $V_u = P_u$ . Finally, the quantity  $P_w$  is defined as the working shear load (or working jack load) on a girder and is equal to  $\frac{\sigma_{allow}}{\sigma_y} \cdot P_u$ . Using the existing AASHO specifications,  $P_w = \frac{18}{33} P_u$ .

All the values listed in Table 1 may vary somewhat when calculated using the actual dimensions and yield stresses of the test girders as delivered.

A schematic presentation of the proposed test schedule is shown in Fig. 2. Static tests will be conducted before and after each dynamic test to record deflection and strain readings. If a repair is possible after a fatigue crack is observed, the girder will be tested statically to destruction.

Girder	F1	F2
Web slenderness, $\beta$	267	267
Stiffener spacing, $a$	1.50	1.00
Test Section, $I_m$	17,560 in. <sup>4</sup>	17,560 in. <sup>4</sup>
Test Section, $S$	675 in. <sup>3</sup>	675 in. <sup>3</sup>
End Section, $I_e$	19,510 in. <sup>4</sup>	19,510 in. <sup>4</sup>
End Section with Cover Plates, $I$	34,960 in. <sup>4</sup>	34,960 in. <sup>4</sup>
$M_y$	22,280 k-in.	22,280 k-in.
$M_p$	24,060 k-in.	24,060 k-in.
$P_y$	172 k	172 k
$P_p$	179 k	179 k
$\tau_{cr}$	2.68 ksi	3.51 ksi
$P_{cr}$	25 k	33 k
$P_u = V_u$	99 k	122 k
$P_w$	54 k	66.5 k

TABLE 1

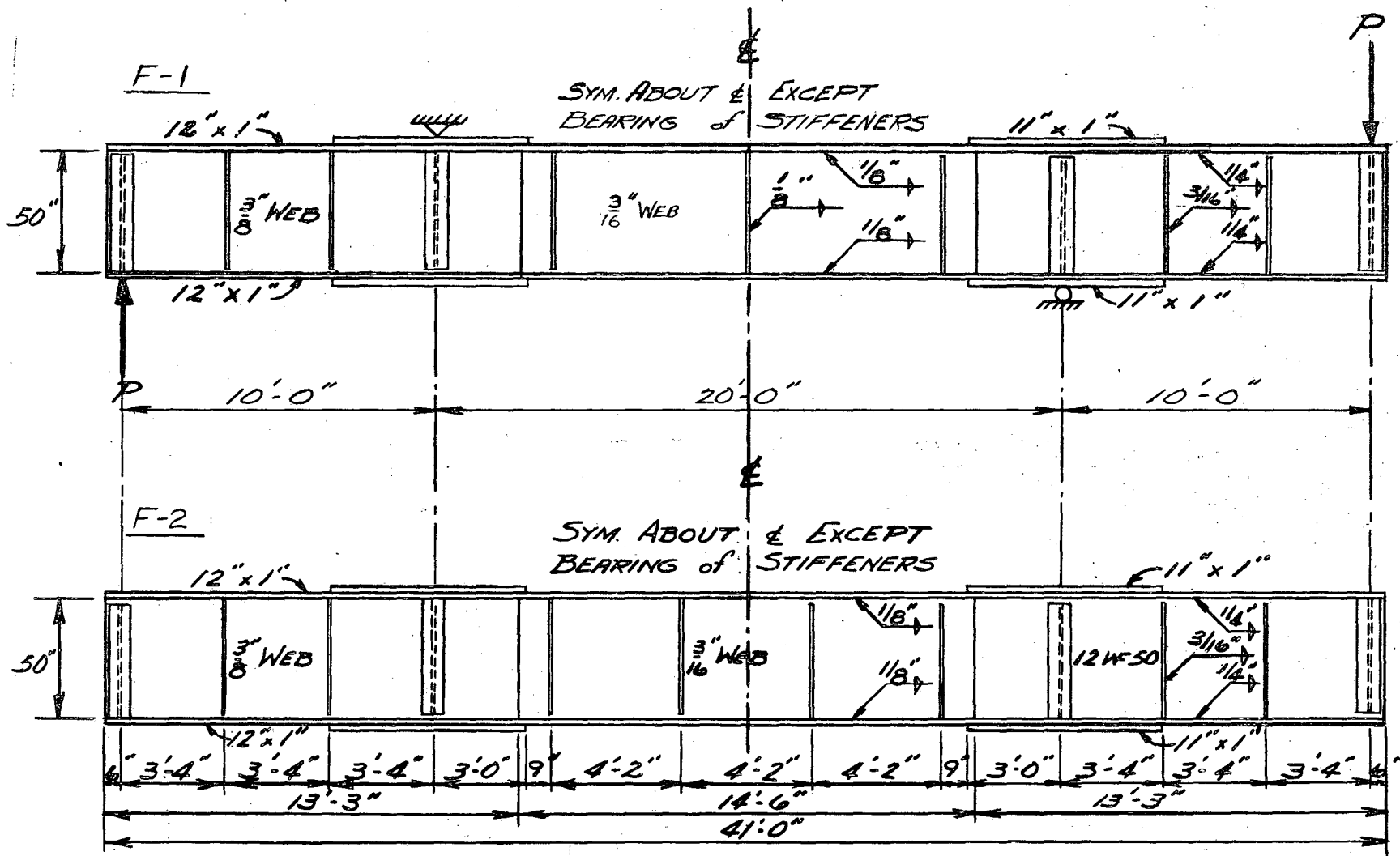
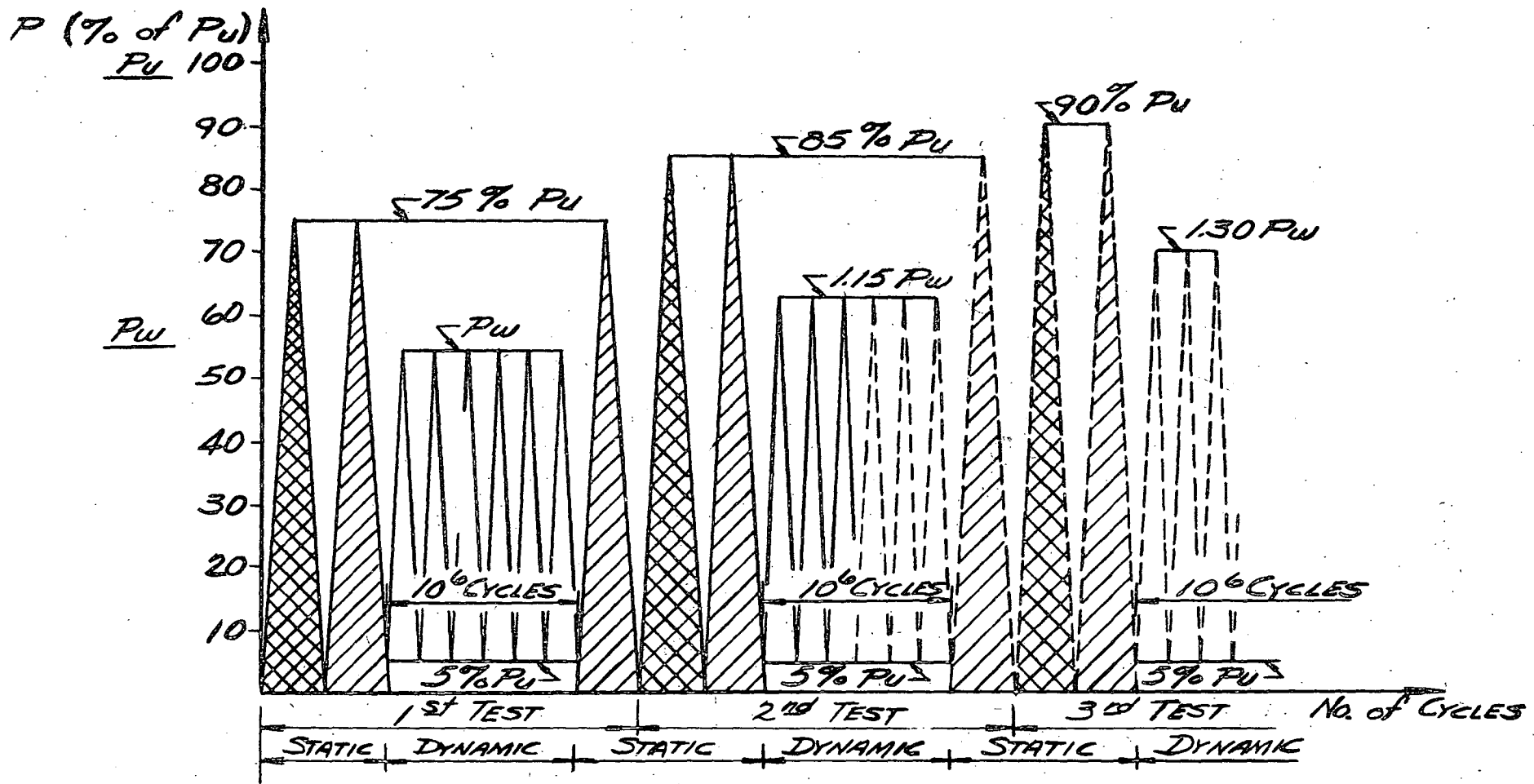


Fig. 1 - Proposed Test Girders F1 and F2





  
 Preliminary Static Cycle  
 (visual observations)

  
 Static Cycle  
 (instrument observations)

  
 Dynamic Cycles

  
 Proposed Cycles if  
 No Failure First

Fig. 2 - Proposed Test Schedule

File 251

July 27, 1960

TO: Members of the Welded Plate Girder Project Committee

Messrs: E. L. Erickson      J. A. Gilligan      W. B. McLean  
         A. Amirikian      LaMotte Grover      N. W. Morgan  
         → L. S. Beedle      T. R. Higgins      W. H. Munse  
         Karl de Vries      W. H. Jameson      E. J. Ruble  
         F. H. Dill      C. D. Jensen      J. E. South  
         Neil van Eenam      Knut Jensen      R. M. Stuchell  
         E. R. Estes      Bruce G. Johnston      Bruno Thürlimann  
         G. F. Fox      K. H. Koopman      J. Vasta  
                                  W. Spraragen      George Winter

Gentlemen:

At the June 2nd-Committee Meeting the Project Staff was requested to investigate the potential of existing fatigue equipment here at Fritz Engineering Laboratory and prepare a proposal for discussion in the next Committee Meeting provided the equipment could be used for fatigue tests on full sized girders. At that time we did not think this was possible; we were pleased to find, since then, that our equipment is adequate to fatigue test girders of the size outlined in the enclosed proposal.

We propose to test two girders in time to enable us to present some results at the next Committee Meeting. In order to do this, may we ask you to review the proposal as soon as possible and give us your comments and approval or disapproval of the general scheme by August 15th?

Sincerely yours,

B. T. Yen  
Project Supervisor

Lynn S. Beedle  
Project Director

BTY:lm

Encl.