4. Provide the paving community a systematic treatment of (a) the conditions responsible for the loss of pavement performance due to water in its various states or as induced by water-temperature interaction, (b) means of predicting loss of performance, and (c) means for developing solutions to adhesion problems.

RESEARCH PROBLEM STATEMENTS

COMMITTEE ACTIVITY

DESIGN AND CONSTRUCTION OF TRANSPORTATION FACILITIES
John L. Beaton, Chairman
Group 2 Council

SECTION F - CONSTRUCTION
Robert D. Schmidt, Chairman

COMMITTEE ON CONNECTION PROCEDURES - METAL STRUCTURES
Gerald J. Hill, Chairman

W. G. Gunderman, Staff Engineer

Robert L. Anderson
Philip A. Barnes
Harry E. Broadbent, Jr.
Duane J. Carpenter
M. Frank Couch
Hubert F. Crick
Lamotte Grover
Richard L. Hartzell
Paul E. Masters
Maurice F. Menefee, Jr.
Arthur W. Moon
Theodore A. Mowatt
E. F. Nordlin
Robert A. Norton
Frederick H. Ray
W. W. Sanders, Jr.
Joe Schneider
Robert Williamson Sharp
Jack P. Shedd
James E. Stallmeyer
Jack Sternbach

EVALUATING THE ELECTROSLAG WELDING PROCESS
FOR
DYNAMIC LOADING CONDITIONS

I. Research Problem Statement

Engineers are hesitant to permit the use of the electroslag welding process for weldments subject to dynamic loading because conclusive research has not been performed which can be accepted with some degree of confidence. Hence, this economical welding process although known by many is used by relatively few.

II. The Problem Area

The principle areas of concern are the physical properties of the weld and heat-affected zones and how the many welding parameters, including the flux, welding wire and thickness of the plates joined, affect the properties of these zones. In view of the relatively high heat-input in electroslag welding, the grain size within the weld metal and the nature of the heat-affected zone are dependent upon the magnitude and orientation of the heat sinks. These heat-sinks are provided by the plate material, the dams, and the slag pool. A thorough analytical and experimental program of evaluation of these parameters is dictated.

Considerable information is available worldwide on small-scale and static-loaded test specimens, but little if any on full-scale dynamically loaded members with special interest on the fatigue life of the welded connection.

III. Research Proposed

This program should begin with a thorough search of the literature to take advantage of all the work done to date and to more precisely define the specific problems and areas for investigation.

Current small-scale testing methods could be employed to determine some of the effects of the many parameters of this welding process and for later correlations with the dynamic results. Such testing would provide information which would determine the future course of action for the full-scale dynamic tests and eliminate some of the variables having minimal effects on the physical properties of the weld and heat-affected zones.

Parameters which should be evaluated in this initial testing phase would be voltage and current variations which can be permitted for a given joint dimensions and slag depths; types of flux and their tolerance of operating at high voltages; acceptable methods of adding flux and measuring slag depth; welding wires for the various types of steel and their contribution to copper and other element segregations at the grain boundaries influencing intergranular micro and macro cracking; types of dams; effect of water temperature of the water-cooled type; the desirability of preheat, postheat, and retarded cooling; application of dual wire or oscillation relative to thickness; and the effects of the heat sinks.

Special investigation should be made into the possibility of copper segregation at grain boundaries when welding ASTM A588 steel with compatible electrodes such as RACO's 815.

The results of this research program should make specific recommendations as to the best electrode and flux combination for welding ASTM A588 steel, with a chemistry match being an additional consideration.

Flange-to-web fillet welds should be incorporated in the full-scale testing program for the A588 steel, with special emphasis on the need for preheat or additional preheat over that required by A.W.S.

IV. Objectives

The objective of the proposed research is to prove the electroslag process usable for dynamic loading conditions or to recommend changes in the current practice which would lead to its use in the bridge building and other related industries.

V. Urgency

Some states are permitting the use of the electroslag welding process based on a very limited number of tests, some with borderline results. Most of these structures are small and engineers are taking a calculated risk in allowing this unproven process.

Most engineers would not permit its use on a bridge of major proportions because of the existing uncertainties, and therefore this program is of the utmost importance if an economical tool is to be used in the fabrication industry.

An example of the urgency of this program is the fact that a submerged arc butt weld requiring a full 8-hour shift to complete can be made in 20 minutes with the electroslag process. This tremendous difference is comparing only the welding; when the minimal preparation of the joint is considered, electroslag is even more attractive.