Rapid Selection of Column Base Plates

Paper presented by WILLIAM R. BIRD
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Discussion by **R. T. Douty**

The author states that "the selection of the optimum plate geometry cannot be determined directly . . . ."

Actually, that situation is rather well defined mathematically, being known as the mathematical programming problem. This problem simply is to determine the set of values for a given set of variables (e.g., length, width, thickness) which produces the best value for a given combination of those values (e.g., weight) while at the same time satisfying a set of constraining relationships (e.g., bending stress and bearing stress constraints, etc.).

There are direct, rational means of solution to the mathematical programming problem; in fact there has been considerable activity over the past decade directed towards formulating reliable methods for solving the problem when it is cast in a structural design context. Even though solutions to this particularly difficult problem have not come easily for nontrivial structures, the profession should be aware that there is continuing progress in transferring this novel technology to the profession at large, primarily through computer programs because of the large number of calculations which are involved. As just one example of particular relevance to this discussion, there happens to be a program on several widely accessible time-sharing networks which does generate optimal column base plates directly by mathematical programming techniques, thus affording a convenient comparison between a design produced by graphical aids, such as those in Bird's paper, and a comparative design produced by a method using direct-design procedures. After dialing and logging in on one of these (in this case the Compu-Serv Network) by any engineer having access to a telephone, a terminal, and a valid account number, the exchange between the engineer and the time-sharing network would proceed as shown in Fig. 1. (Information typed and transmitted by the engineer is shown underlined.)

At present rates the design which is generated, approximately 5.0 percent less in weight than Bird's similar

R. T. Douty is Professor of Civil Engineering, University of Missouri-Columbia.

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REQUEST BASEPL

ENTER CASE DATA-

ID BIRD EXAMPLE 2
DATA  P 825  FPC 6  FY 50  SHAPE 14.103
CONDITION  UM PLATE
GO


        BASE PLATE DESIGN PROGRAM
        1969 AISC SPEC, SUP 3


GIVEN DATA -   BIRD EXAMPLE 2
 P   =  825.00 KIPS
 FPC =    6.00 KSI
 CB  =  14.575 IN
 CD  =  14.250 IN
 FY  =   50.00 KSI
 CONCRETE AREA SAME AS BASE PLATE



 FLOATING VARIABLES


 B :  16.58 - 40.00
 N :  16.25 - 40.00
 T :   0.25 -  4.00

BEGIN SOLUTION-
-SOLUTION COMPLETED

    B        N        T
 19.000   20.794    1.500


  BEARING STRESS =   2.088 KSI

  PLATE BENDING STRESS
     PARALLEL TO FLANGE = 37.500 KSI
     NORMAL TO FLANGE   = 36.653 KSI
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Fig. 1. Direct design of column base plates by computer network time-sharing

Example 2 because of the slightly thinner plate which is generated, was obtained for $1.30. (As is typical with timesharing networks, this can be reduced about one-third by running in off-prime time periods.) While in this instance this may or may not be that more time saving or economically advantageous than employing a graphical aid, it is noteworthy that the same program operates in the same manner for moment-carrying plates, designing the anchor bolts as well as the plate, a situation not easily handled with graphical aids.